EXHIBIT E

US011106352B2

(12) **United States Patent**
Tyler

(10) **Patent No.: US 11,106,352 B2**
(45) **Date of Patent: Aug. 31, 2021**

(54) **DEVICES, METHODS, AND GRAPHICAL USER INTERFACES FOR ACCESSING NOTIFICATIONS**

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(72) Inventor: **William M. Tyler**, San Francisco, CA (US)

(73) Assignee: **APPLE INC.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/915,971**

(22) Filed: **Jun. 29, 2020**

(65) **Prior Publication Data**

US 2020/0333935 A1 Oct. 22, 2020

Related U.S. Application Data

(63) Continuation of application No. 16/354,012, filed on Mar. 14, 2019, which is a continuation of application (Continued)

(51) **Int. Cl.**
G06F 3/0488 (2013.01)
G06F 1/3234 (2019.01)
(Continued)

(52) **U.S. Cl.**
CPC .... ***G06F 3/0488*** (2013.01); ***G06F 1/1694*** (2013.01); ***G06F 1/3262*** (2013.01); (Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

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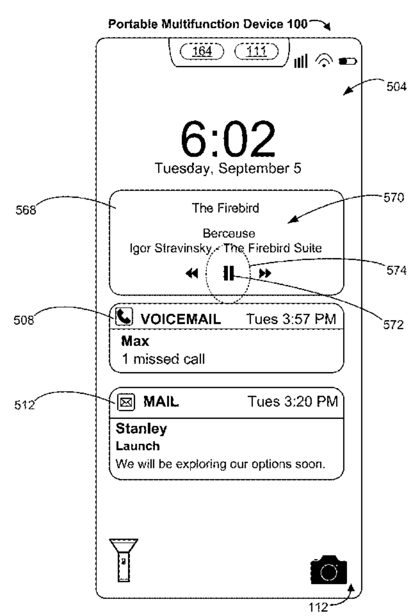
(Continued)

Primary Examiner — Toan H Vu
(74) *Attorney, Agent, or Firm* — Morgan, Lewis & Bockius LLP

(57) **ABSTRACT**

While displaying the wake screen user interface, in response to detecting a first input that is directed to a portion of the wake screen user interface: if the first input includes first movement in a first direction, the computer system displays of a home screen user interface; and the first movement is in a second direction, the computer system displays a widget screen user interface that is different from the wake screen user interface and the home screen user interface, wherein the widget screen user interface includes a plurality of user interface objects corresponding to different applications, wherein a respective user interface object of the plurality of user interface objects contains application content from an application corresponding to the respective user interface object, and when selected, causes display of an application corresponding to the respective user interface object.

24 Claims, 253 Drawing Sheets



Related U.S. Application Data

No. 15/715,005, filed on Sep. 25, 2017, now Pat. No. 10,466,889.

(60) Provisional application No. 62/507,181, filed on May 16, 2017.

(51) **Int. Cl.**

H04M 1/673	(2006.01)
H04L 12/58	(2006.01)
G06F 21/36	(2013.01)
G06F 3/0481	(2013.01)
G06F 1/16	(2006.01)
G06F 3/01	(2006.01)
G06F 3/0485	(2013.01)
G06F 21/62	(2013.01)
H04M 1/724	(2021.01)
H04M 1/72436	(2021.01)

(52) **U.S. Cl.**

CPC ***G06F 1/3265*** (2013.01); ***G06F 3/016*** (2013.01); ***G06F 3/0485*** (2013.01); ***G06F 3/04817*** (2013.01); ***G06F 3/04883*** (2013.01); ***G06F 21/36*** (2013.01); ***G06F 21/629*** (2013.01); ***H04L 51/24*** (2013.01); ***H04M 1/673*** (2013.01); ***H04M 1/724*** (2021.01); *H04L 51/32* (2013.01); *H04M 1/72436* (2021.01); *H04M 2250/22* (2013.01)

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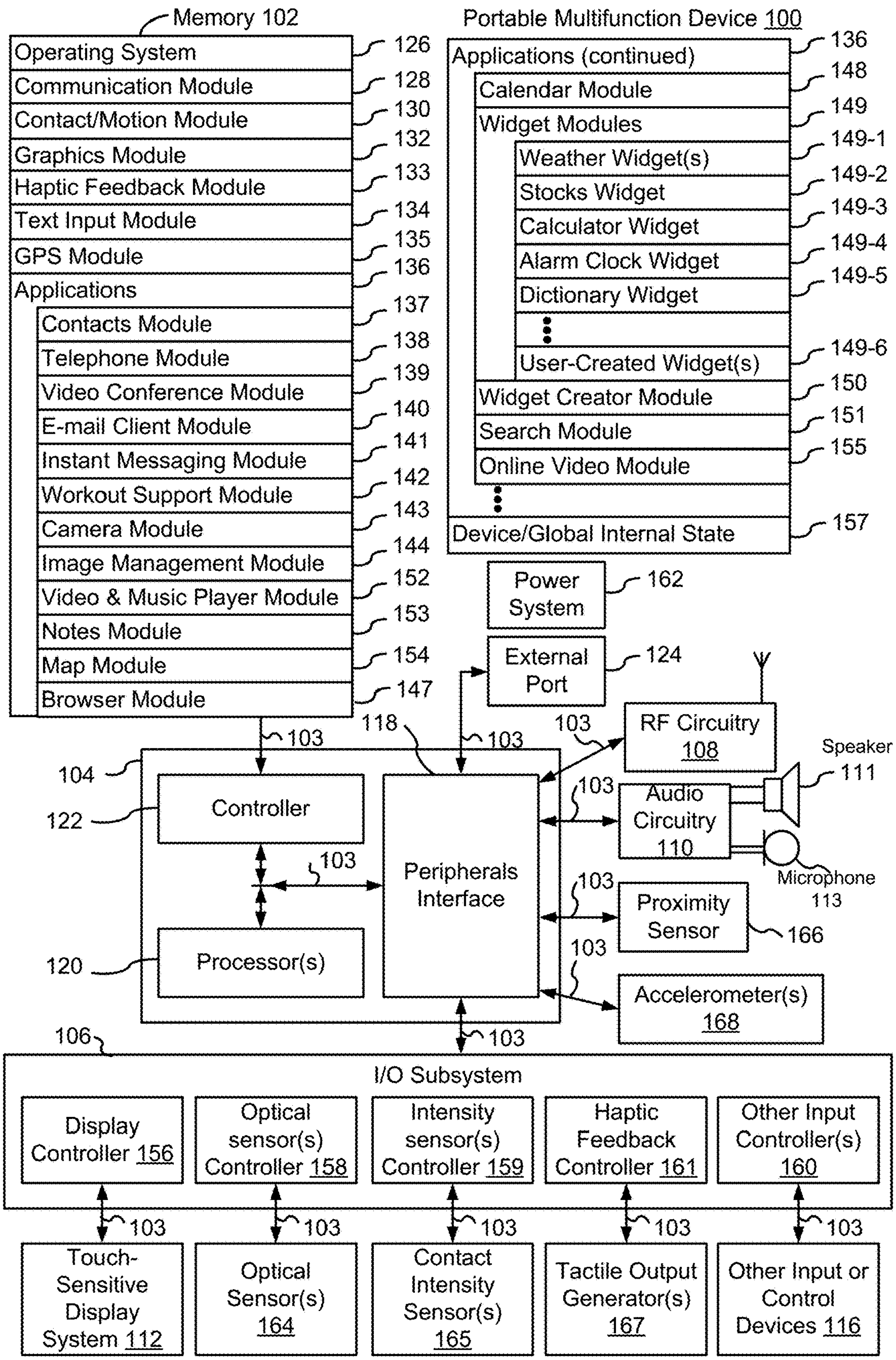
Notice of Allowance, dated Mar. 4, 2020, received in U.S. Appl. No. 16/354,012, 8 pages.
Notice of Allowance, dated Jul. 1, 2020, received in U.S. Appl. No. 16/354,012, 8 pages.
Invitation to Pay Additional Fees, dated Aug. 28, 2018, received in International Patent Application No. PCT/US2018/032395, which corresponds with U.S. Appl. No. 15/715,005, 17 pages.
International Search Report and Written Opinion, dated Nov. 6, 2018, received in International Patent Application No. PCT/US2018/032395, which corresponds with U.S. Appl. No. 15/715,005, 20 pages.

* cited by examiner



Memory 102
Operating System 126
Communication Module 128
Contact/Motion Module 130
Graphics Module 132
Haptic Feedback Module 133
Text Input Module 134
GPS Module 135
Applications 136
Contacts Module 137
Telephone Module 138
Video Conference Module 139
E-mail Client Module 140
Instant Messaging Module 141
Workout Support Module 142
Camera Module 143
Image Management Module 144
Video & Music Player Module 152
Notes Module 153
Map Module 154
Browser Module 147
Portable Multifunction Device 100
Applications (continued) 136
Calendar Module 148
Widget Modules 149
Weather Widget(s) 149-1
Stocks Widget 149-2
Calculator Widget 149-3
Alarm Clock Widget 149-4
Dictionary Widget 149-5
User-Created Widget(s) 149-6
Widget Creator Module 150
Search Module 151
Online Video Module 155
Device/Global Internal State 157
Power System 162
External Port 124
RF Circuitry 108
Speaker 111
Audio Circuitry 110
Microphone 113
Proximity Sensor 166
Accelerometer(s) 168
103
118
104
122
Controller
Peripherals Interface
Processor(s)
120
106
I/O Subsystem
Display Controller 156
Optical sensor(s) Controller 158
Intensity sensor(s) Controller 159
Haptic Feedback Controller 161
Other Input Controller(s) 160
Touch-Sensitive Display System 112
Optical Sensor(s) 164
Contact Intensity Sensor(s) 165
Tactile Output Generator(s) 167
Other Input or Control Devices 116

Figure 1A

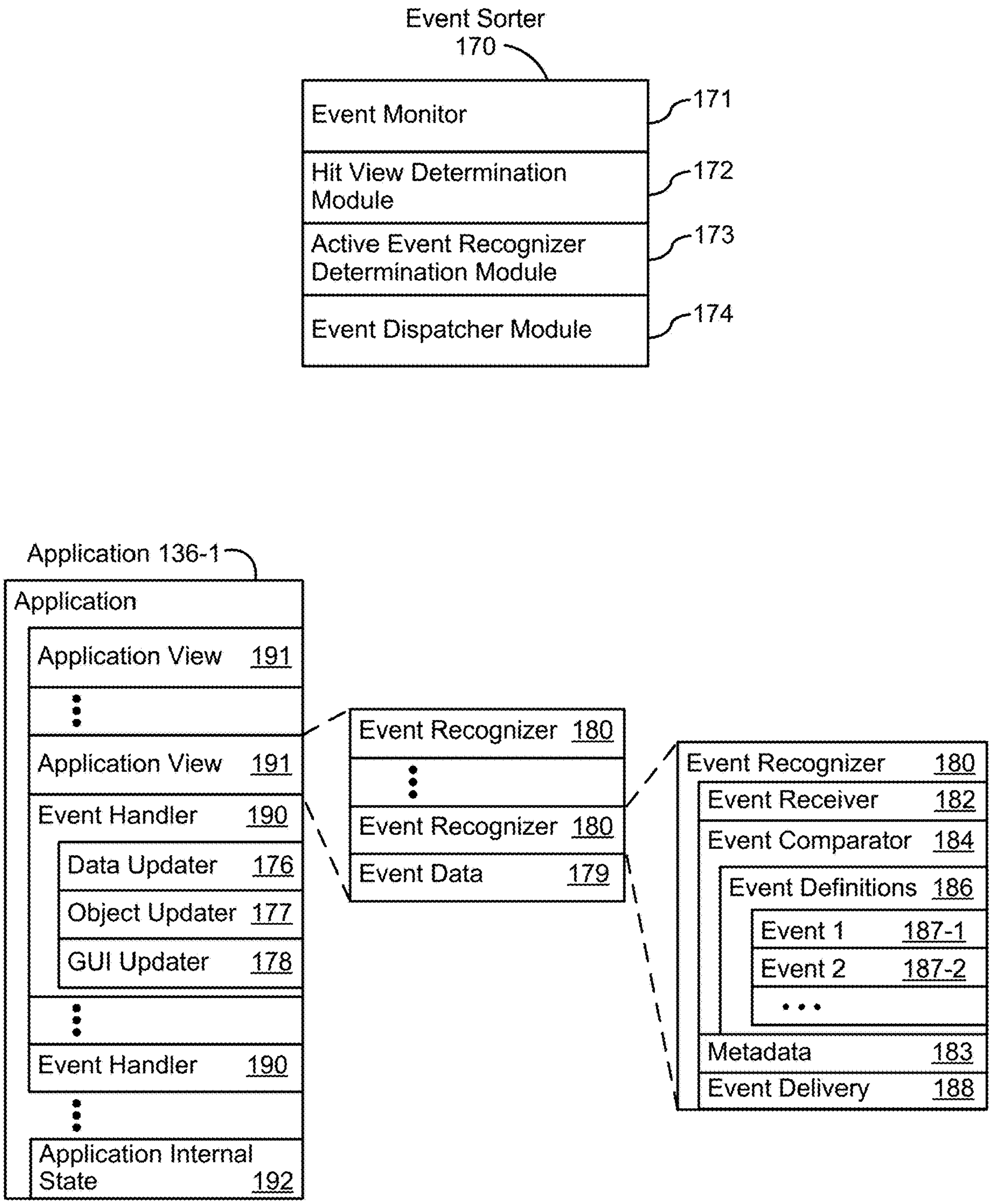
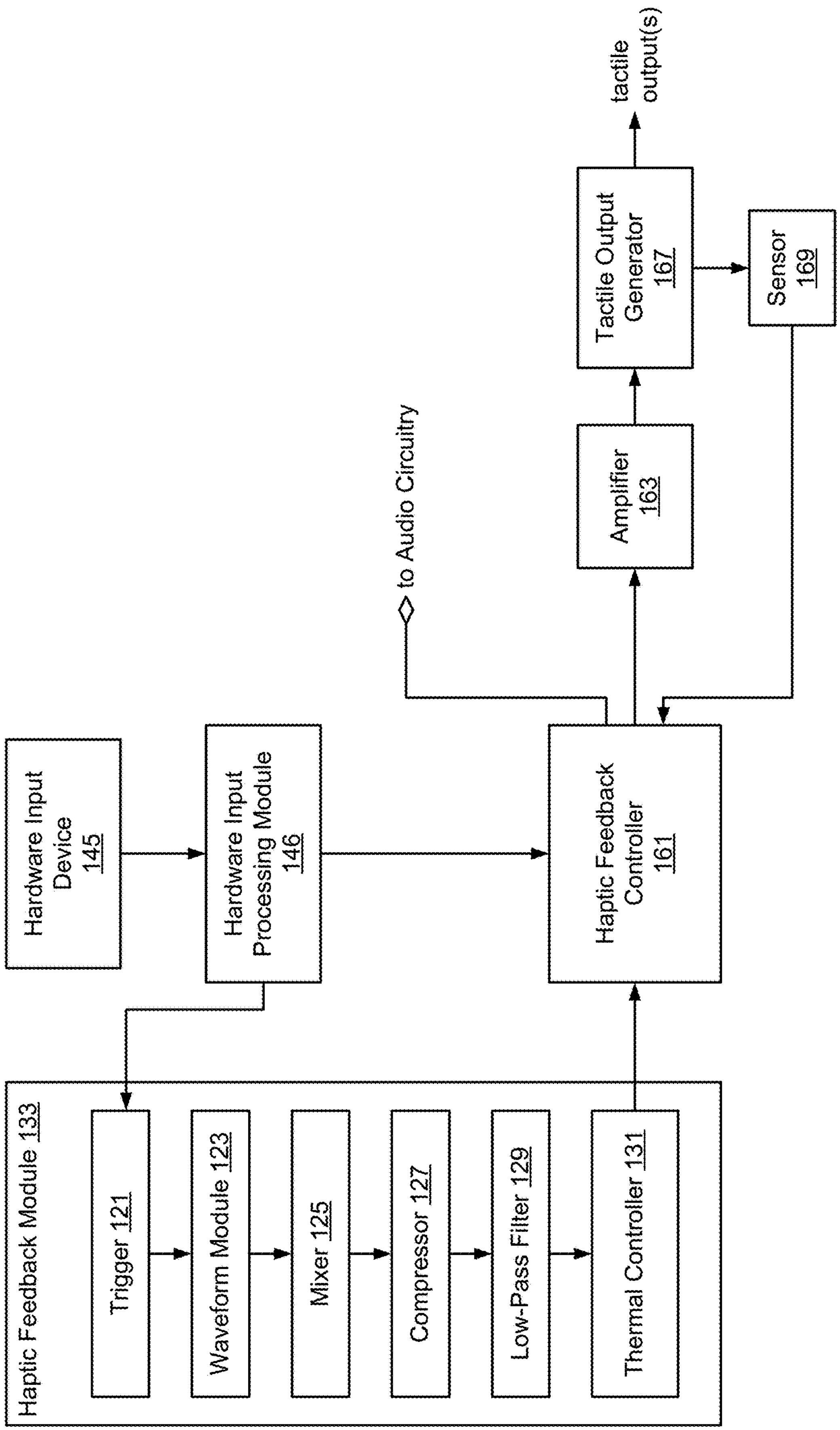

Event Sorter
170
Event Monitor
171
Hit View Determination Module
172
Active Event Recognizer Determination Module
173
Event Dispatcher Module
174
Application 136-1
Application
Application View 191
Application View 191
Event Handler 190
Data Updater 176
Object Updater 177
GUI Updater 178
Event Handler 190
Application Internal State 192
Event Recognizer 180
Event Recognizer 180
Event Data 179
Event Recognizer 180
Event Receiver 182
Event Comparator 184
Event Definitions 186
Event 1 187-1
Event 2 187-2
Metadata 183
Event Delivery 188

Figure 1B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Hardware Input Processing Module 146
Haptic Feedback Controller 161
to Audio Circuitry
Amplifier 163
Tactile Output Generator 167
tactile output(s)
Sensor 169
Haptic Feedback Module 133
Trigger 121
Waveform Module 123
Mixer 125
Compressor 127
Low-Pass Filter 129
Thermal Controller 131

Figure 1C

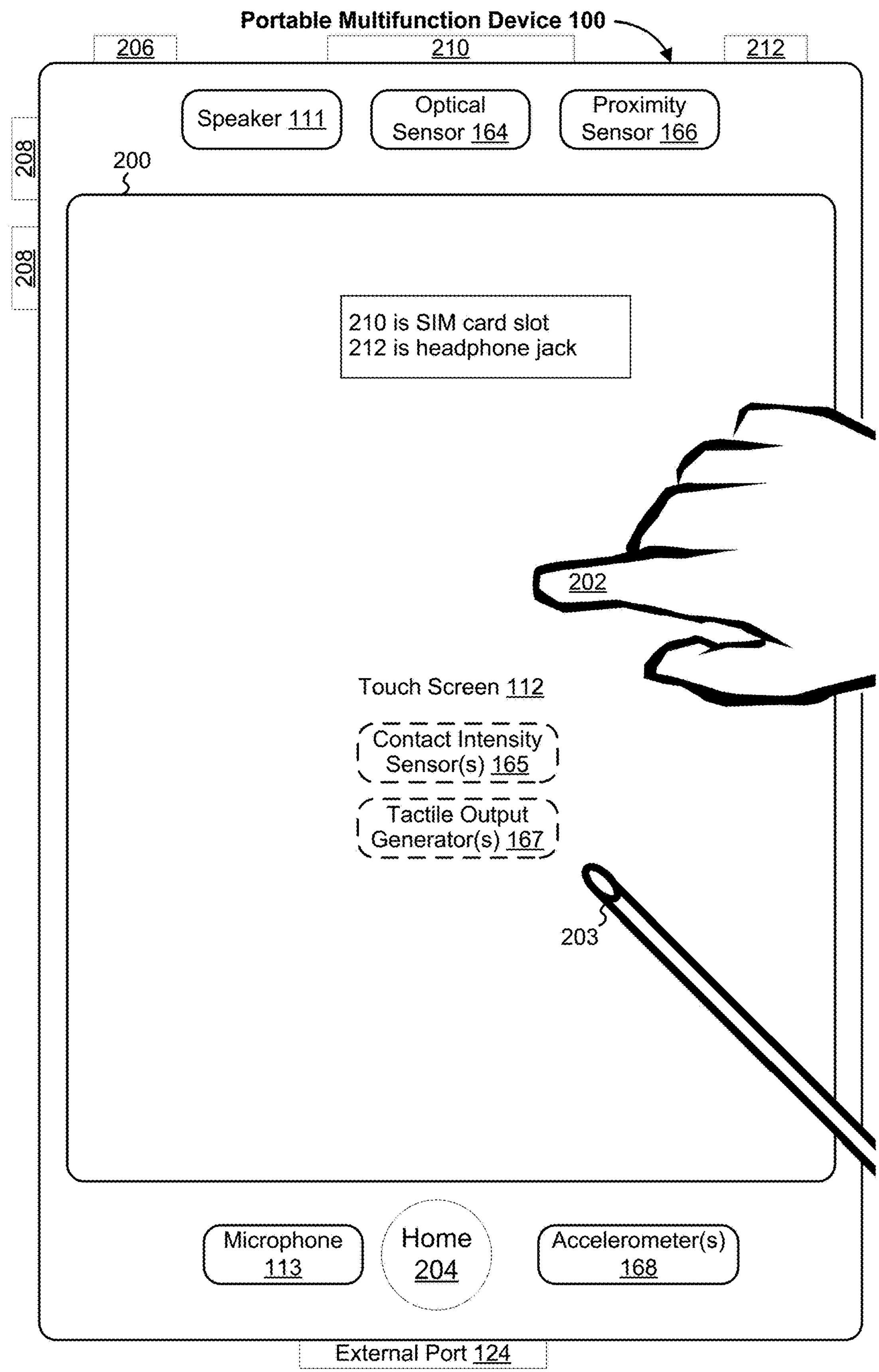
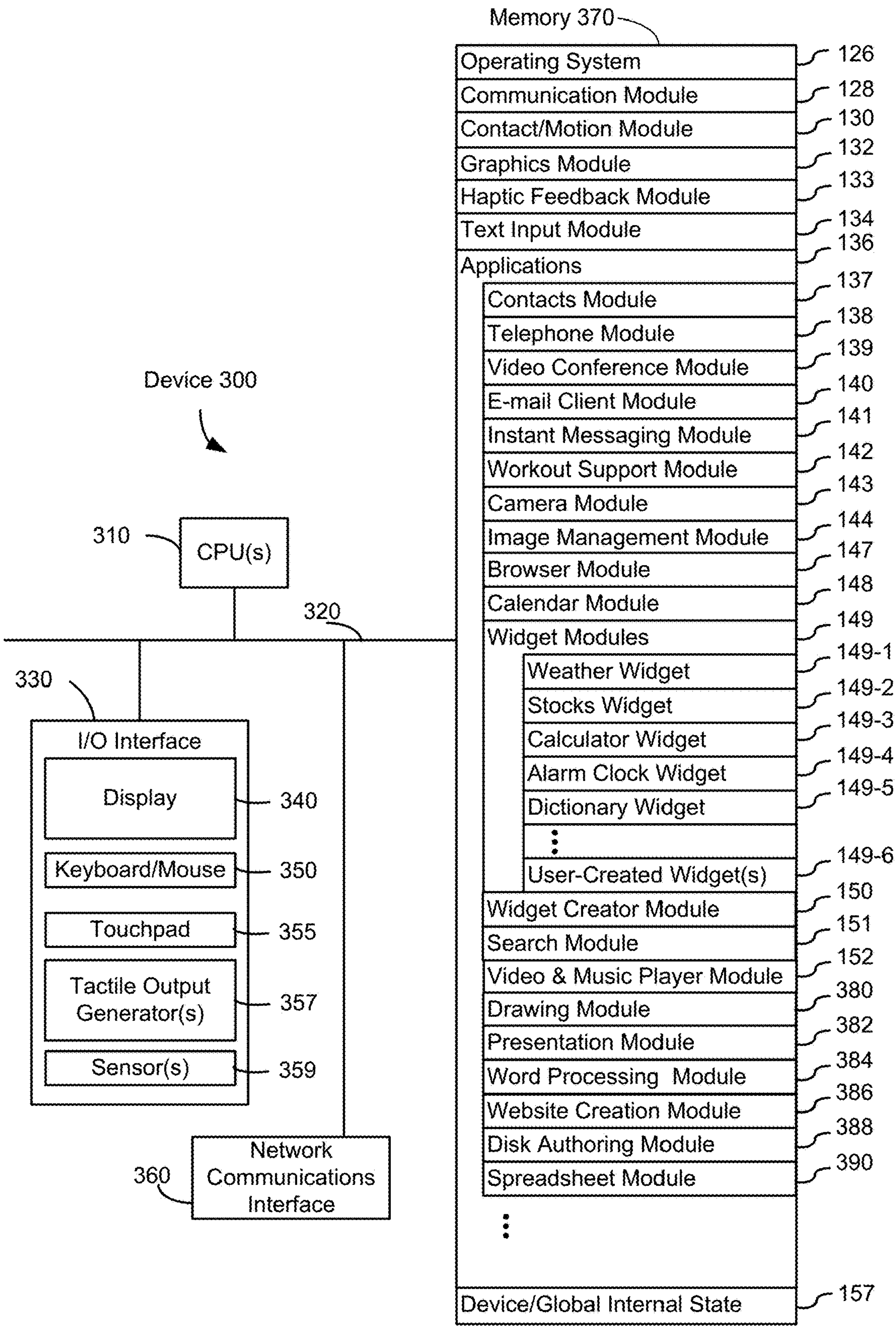

Portable Multifunction Device 100
206
210
212
Speaker 111
Optical Sensor 164
Proximity Sensor 166
208
208
200
210 is SIM card slot
212 is headphone jack
202
Touch Screen 112
Contact Intensity Sensor(s) 165
Tactile Output Generator(s) 167
203
Microphone 113
Home 204
Accelerometer(s) 168
External Port 124

Figure 2


Device 300
310
CPU(s)
320
330
I/O Interface
Display
340
Keyboard/Mouse
350
Touchpad
355
Tactile Output Generator(s)
357
Sensor(s)
359
360
Network Communications Interface
Memory 370
Operating System
126
Communication Module
128
Contact/Motion Module
130
Graphics Module
132
Haptic Feedback Module
133
Text Input Module
134
Applications
136
Contacts Module
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Telephone Module
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Video Conference Module
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E-mail Client Module
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Instant Messaging Module
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Workout Support Module
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Camera Module
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Image Management Module
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Browser Module
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Calendar Module
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Widget Modules
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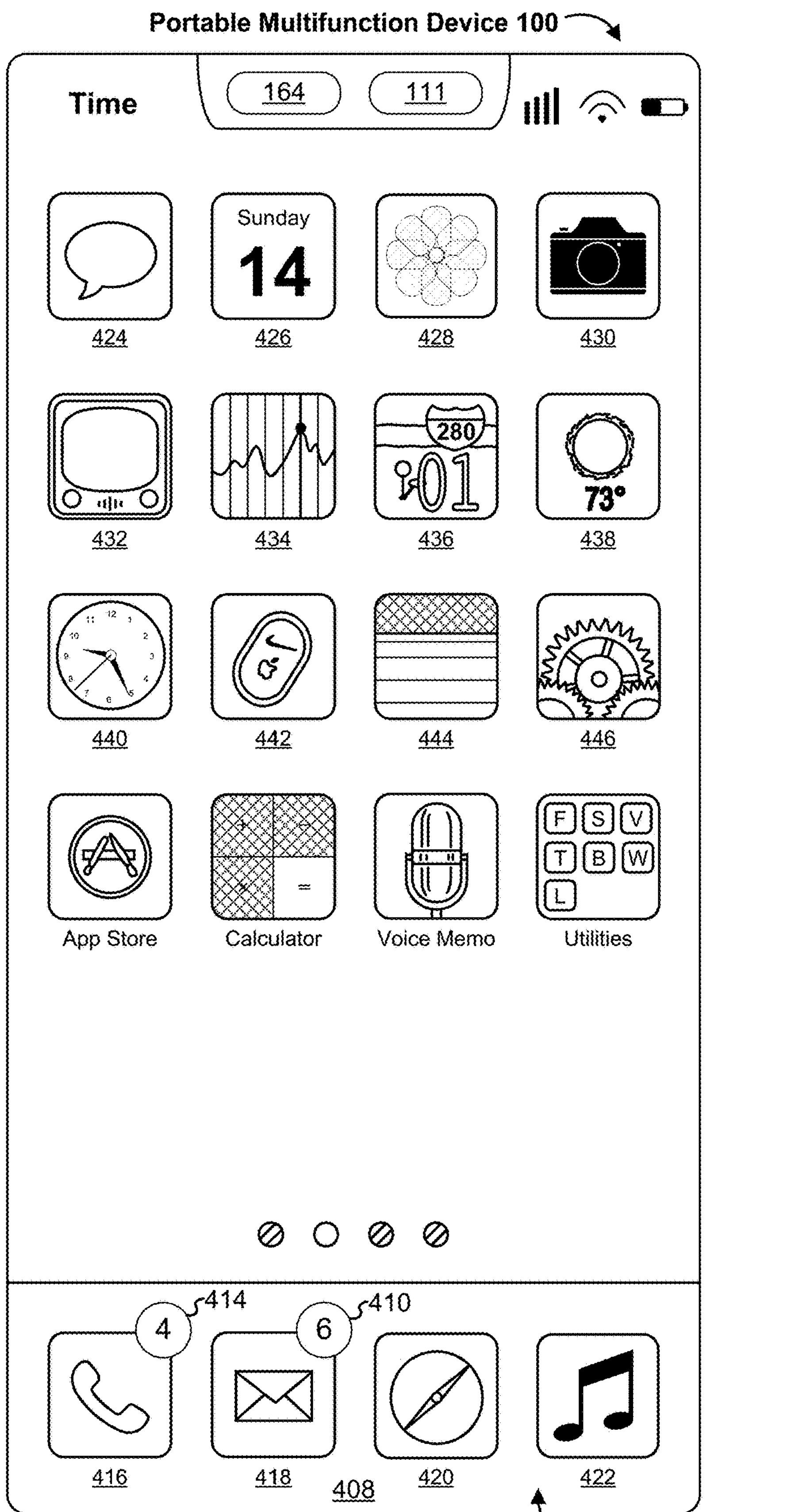
Weather Widget
149-1
Stocks Widget
149-2
Calculator Widget
149-3
Alarm Clock Widget
149-4
Dictionary Widget
149-5
User-Created Widget(s)
149-6
Widget Creator Module
150
Search Module
151
Video & Music Player Module
152
Drawing Module
380
Presentation Module
382
Word Processing Module
384
Website Creation Module
386
Disk Authoring Module
388
Spreadsheet Module
390
Device/Global Internal State
157

Figure 3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446
F S V
T B W
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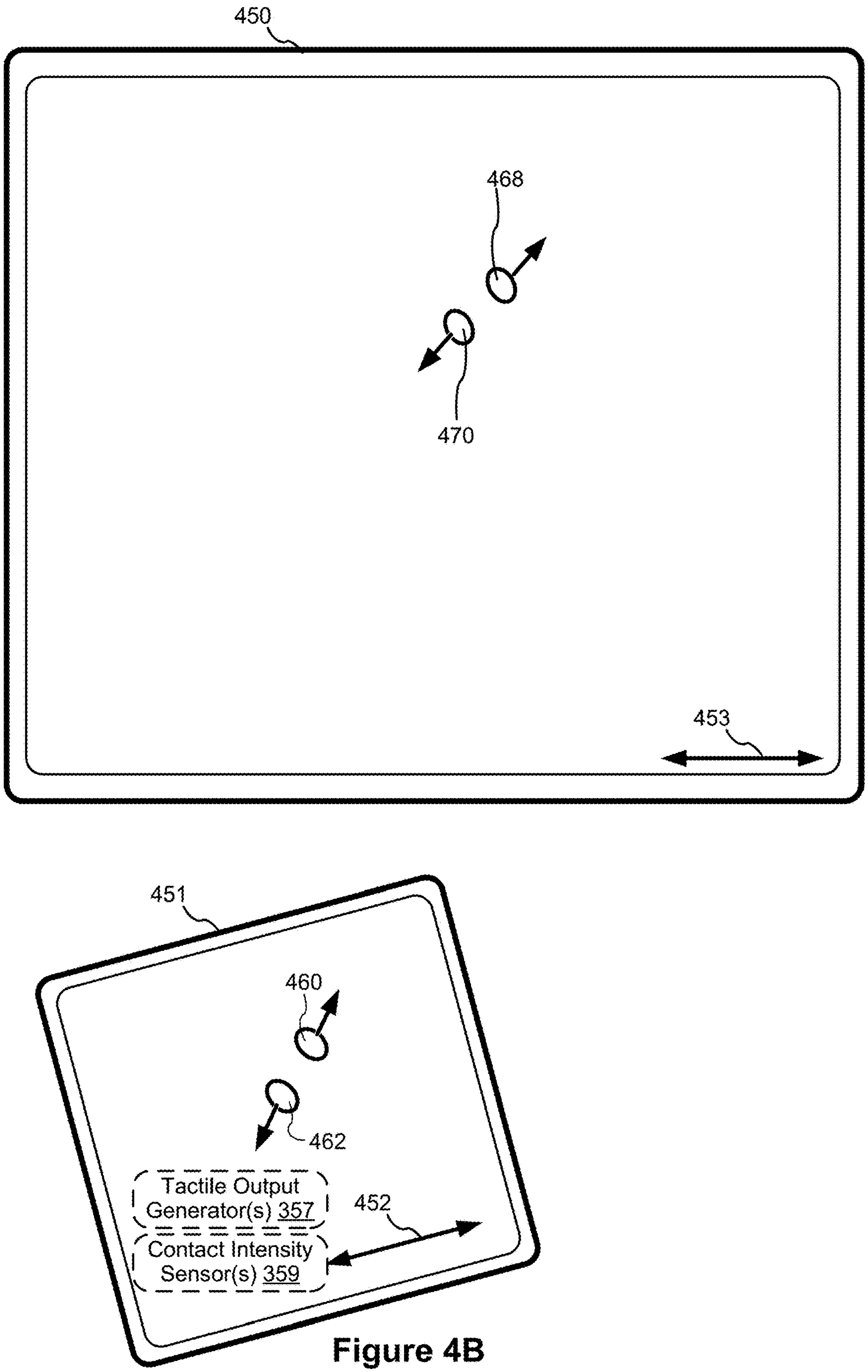
App Store
Calculator
Voice Memo
Utilities
4
414
6
410
416
418
408
420
422
Touch Screen 112

Figure 4A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468
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Tactile Output Generator(s) 357
Contact Intensity Sensor(s) 359
452

Figure 4B

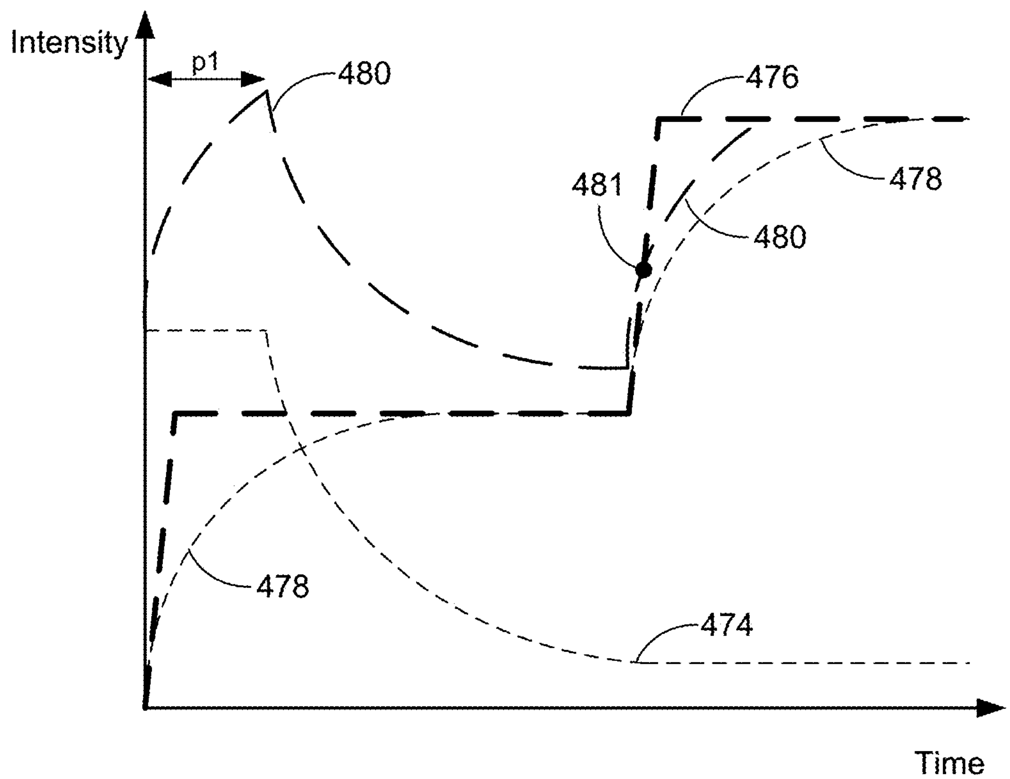


Figure 4C

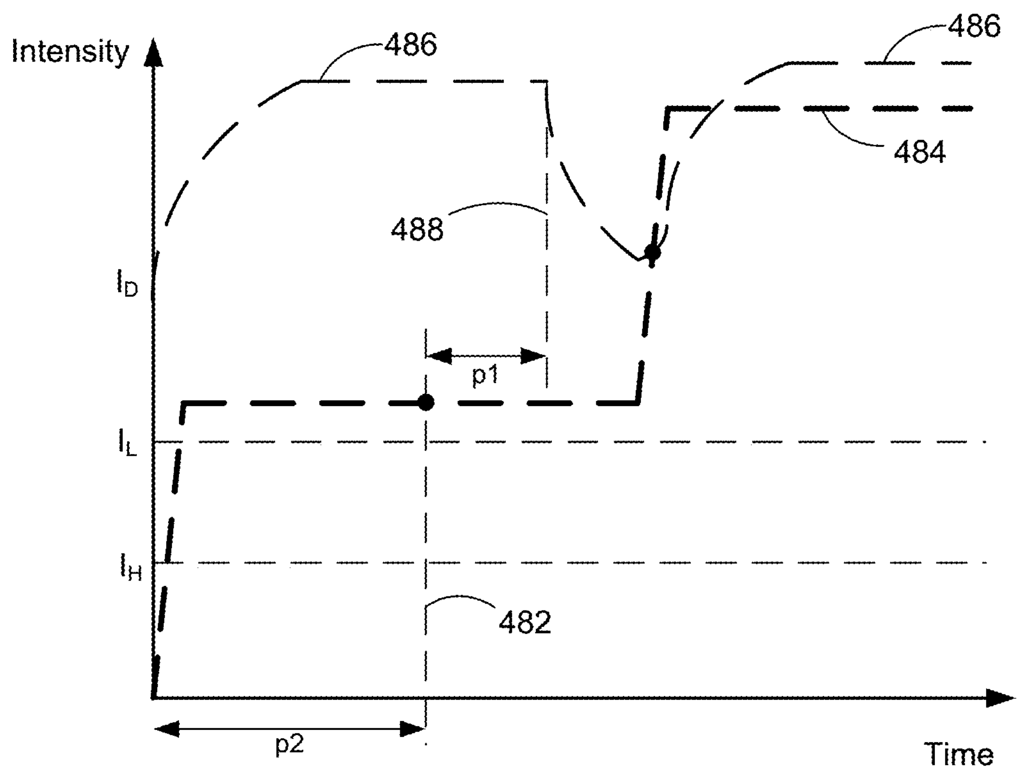
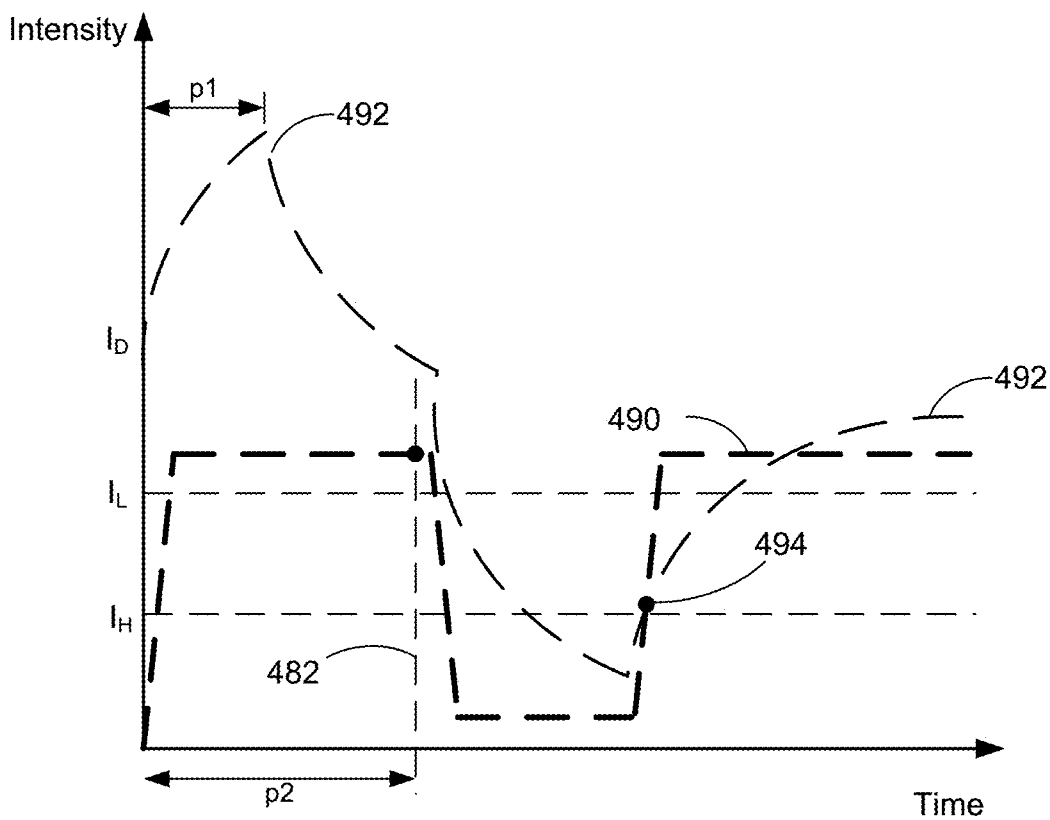


Figure 4D



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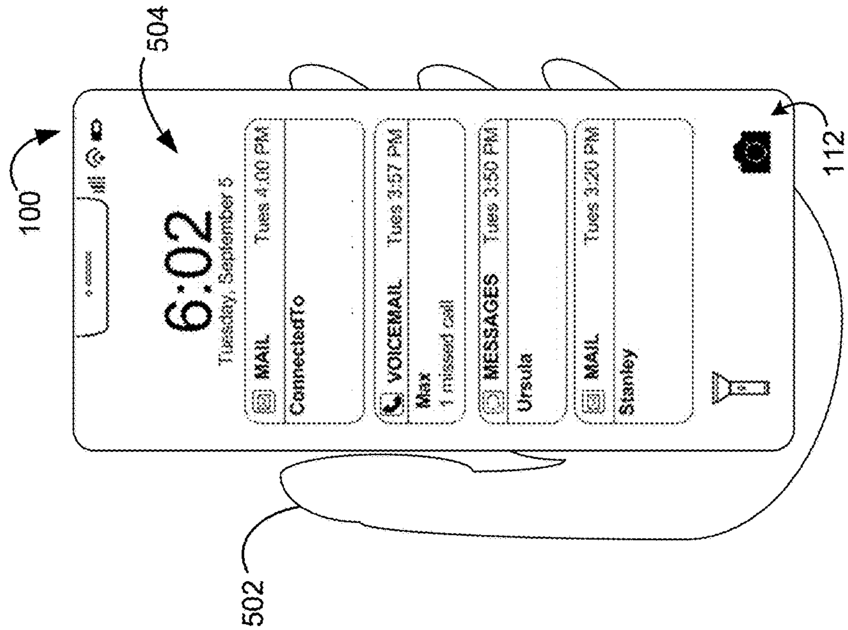


Figure 5A4

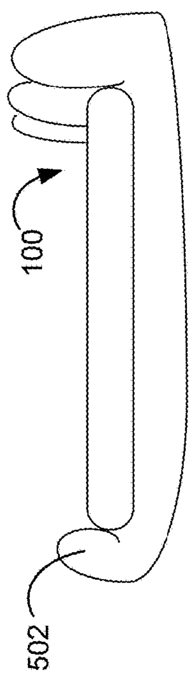


Figure 5A1

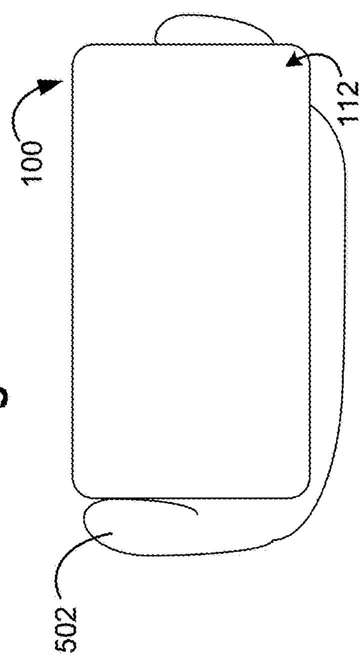


Figure 5A2

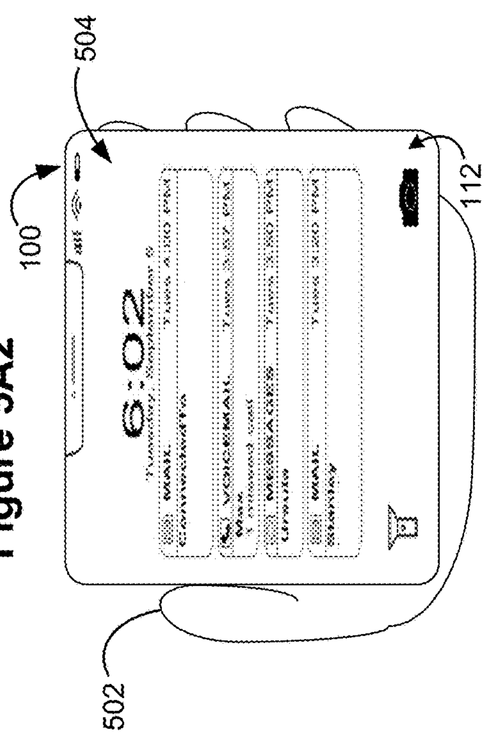
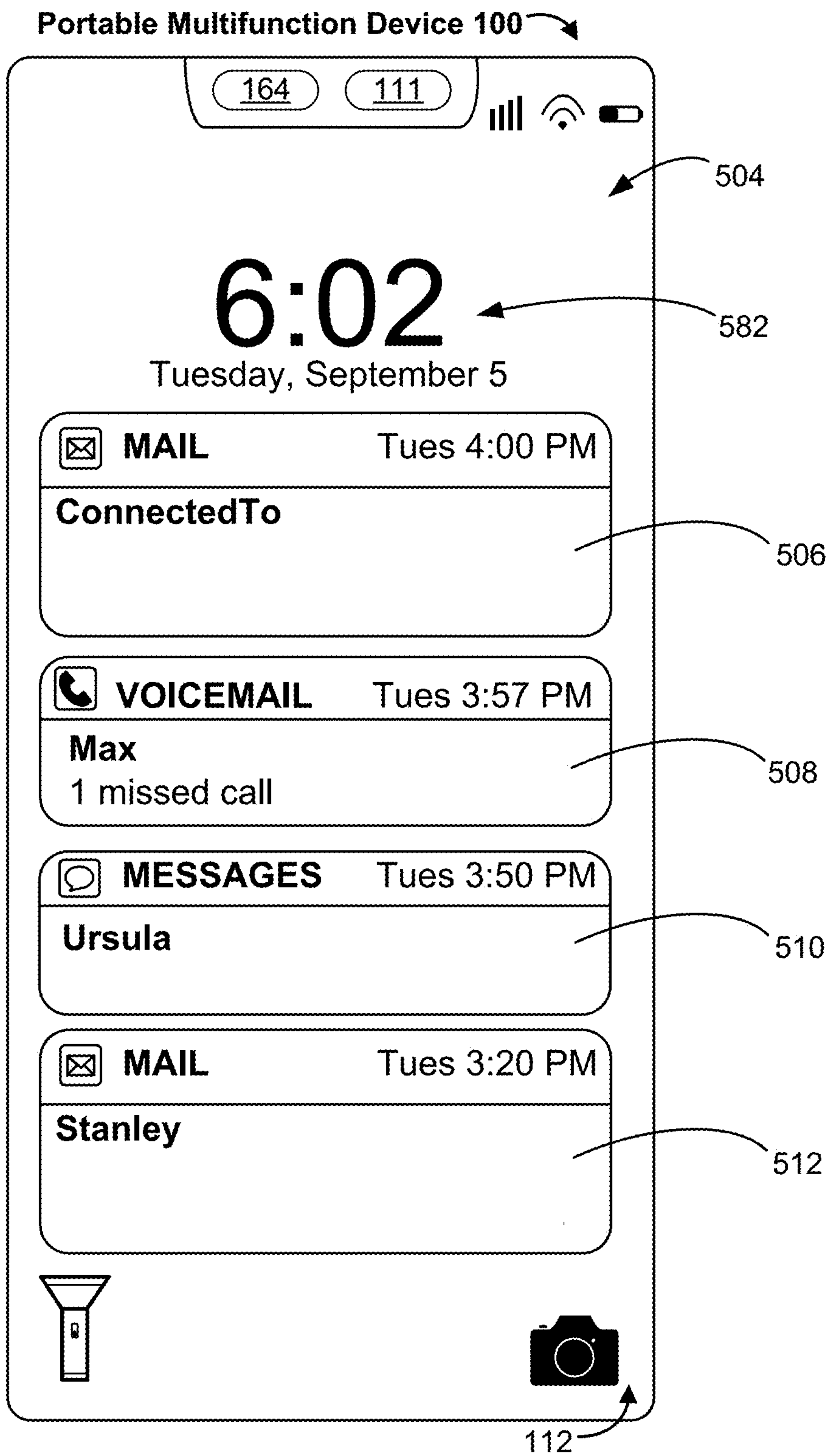


Figure 5A3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VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MESSAGES
Tues 3:50 PM
Ursula
510
MAIL
Tues 3:20 PM
Stanley
512
112

Figure 5B

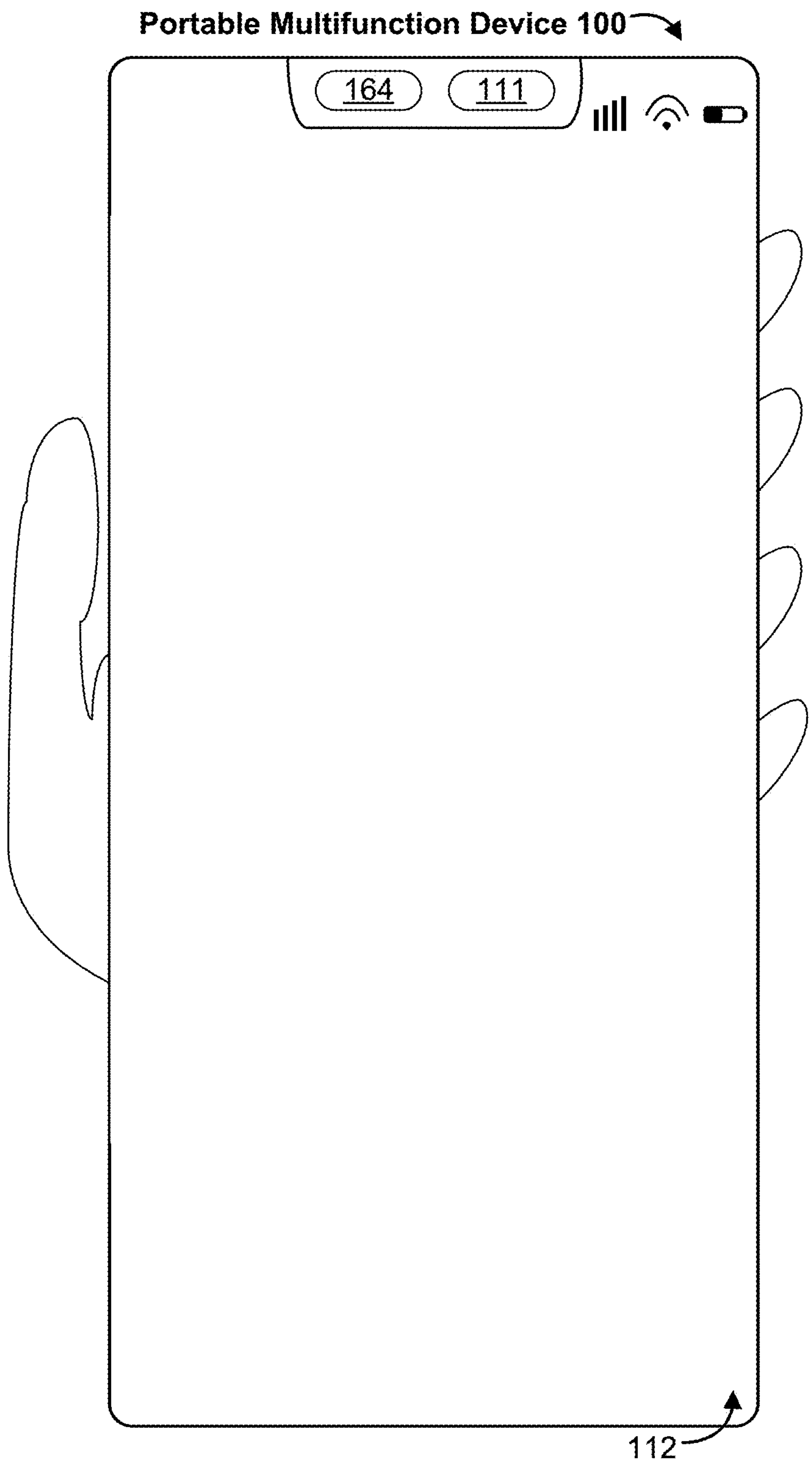
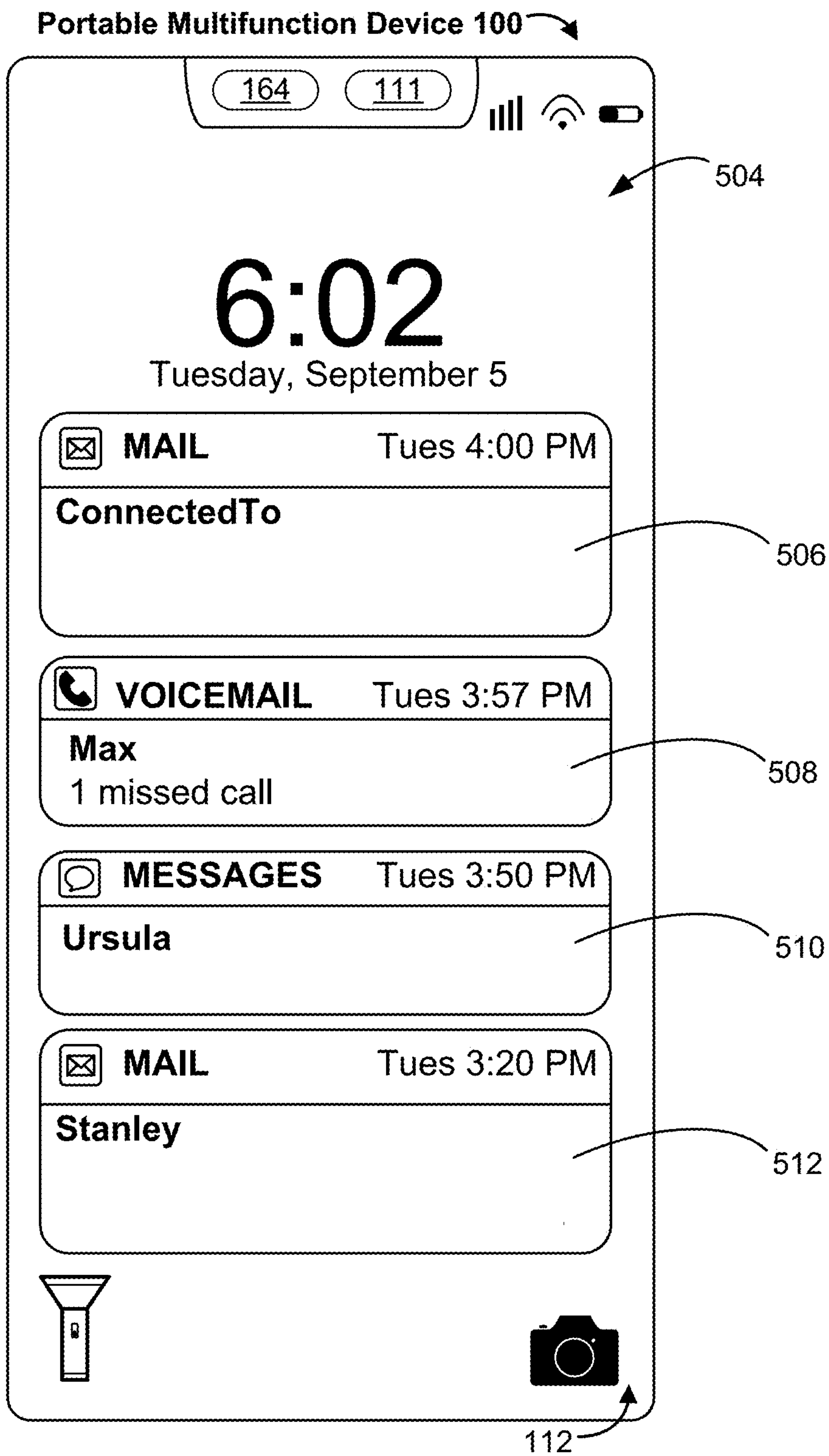


Figure 5C



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Tues 3:50 PM
Ursula
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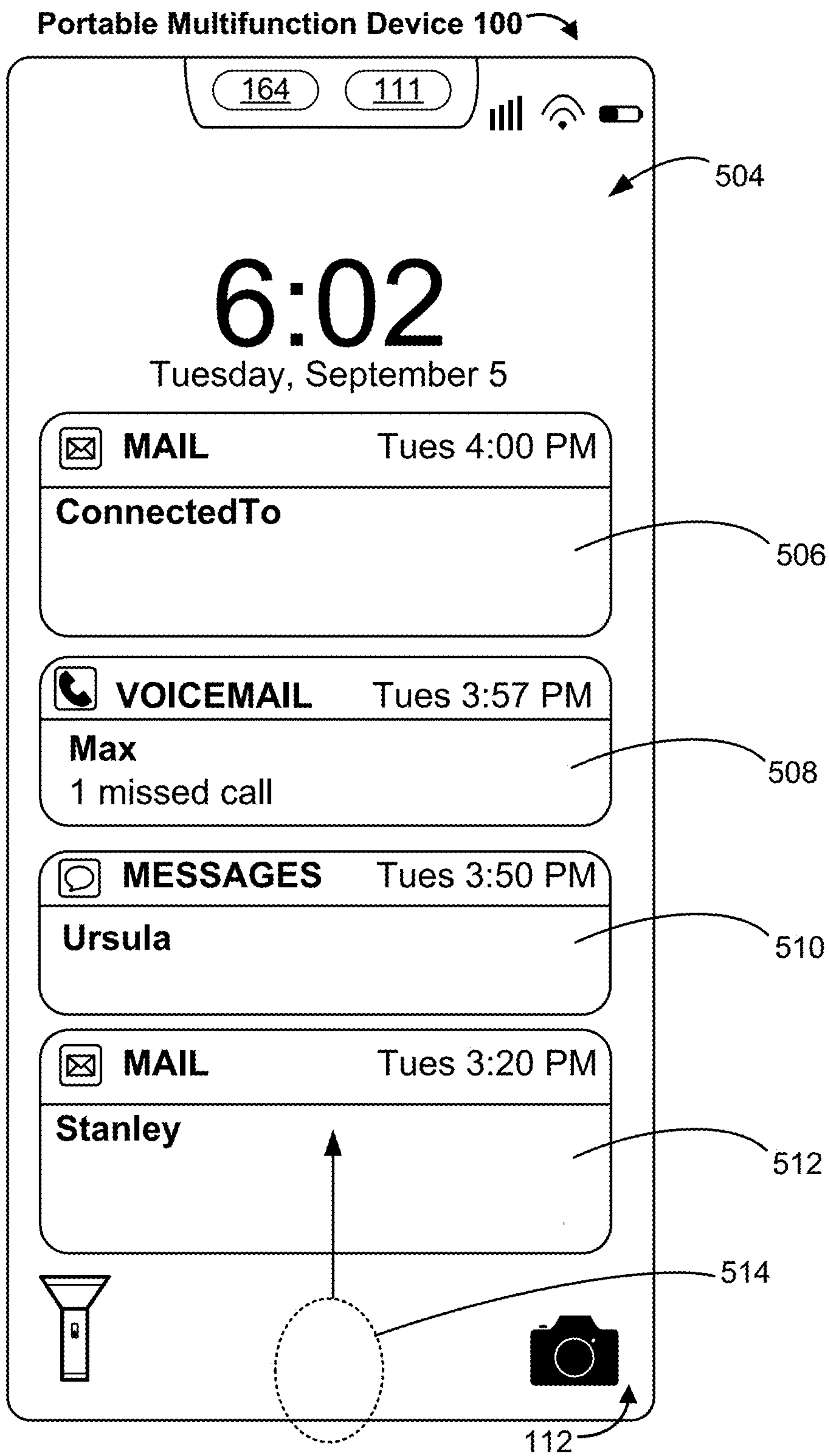
MAIL
Tues 3:20 PM
Stanley
512
112

Figure 5D



Portable Multifunction Device 100
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514
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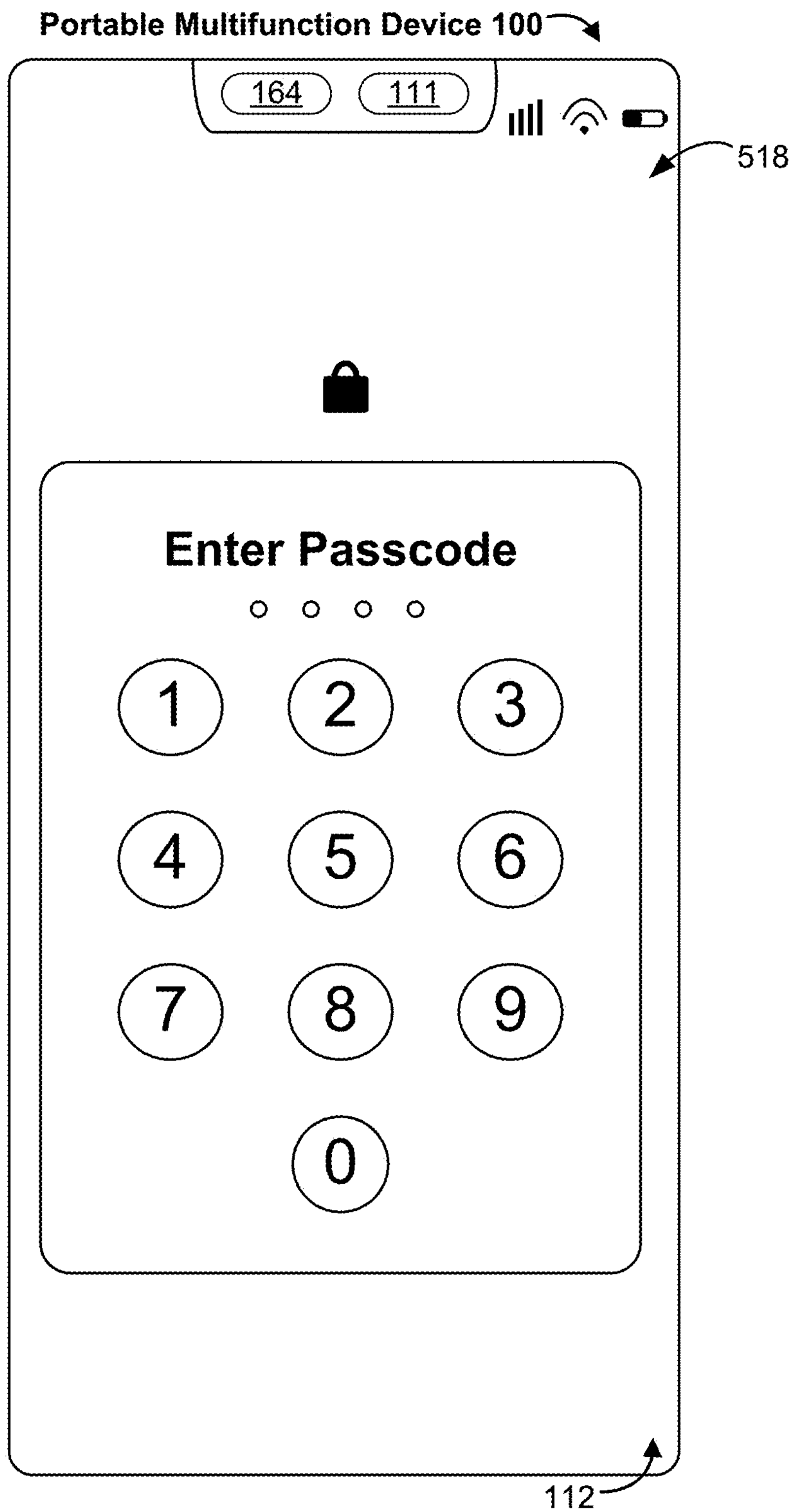
Figure 5E



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9
0
112

Figure 5F

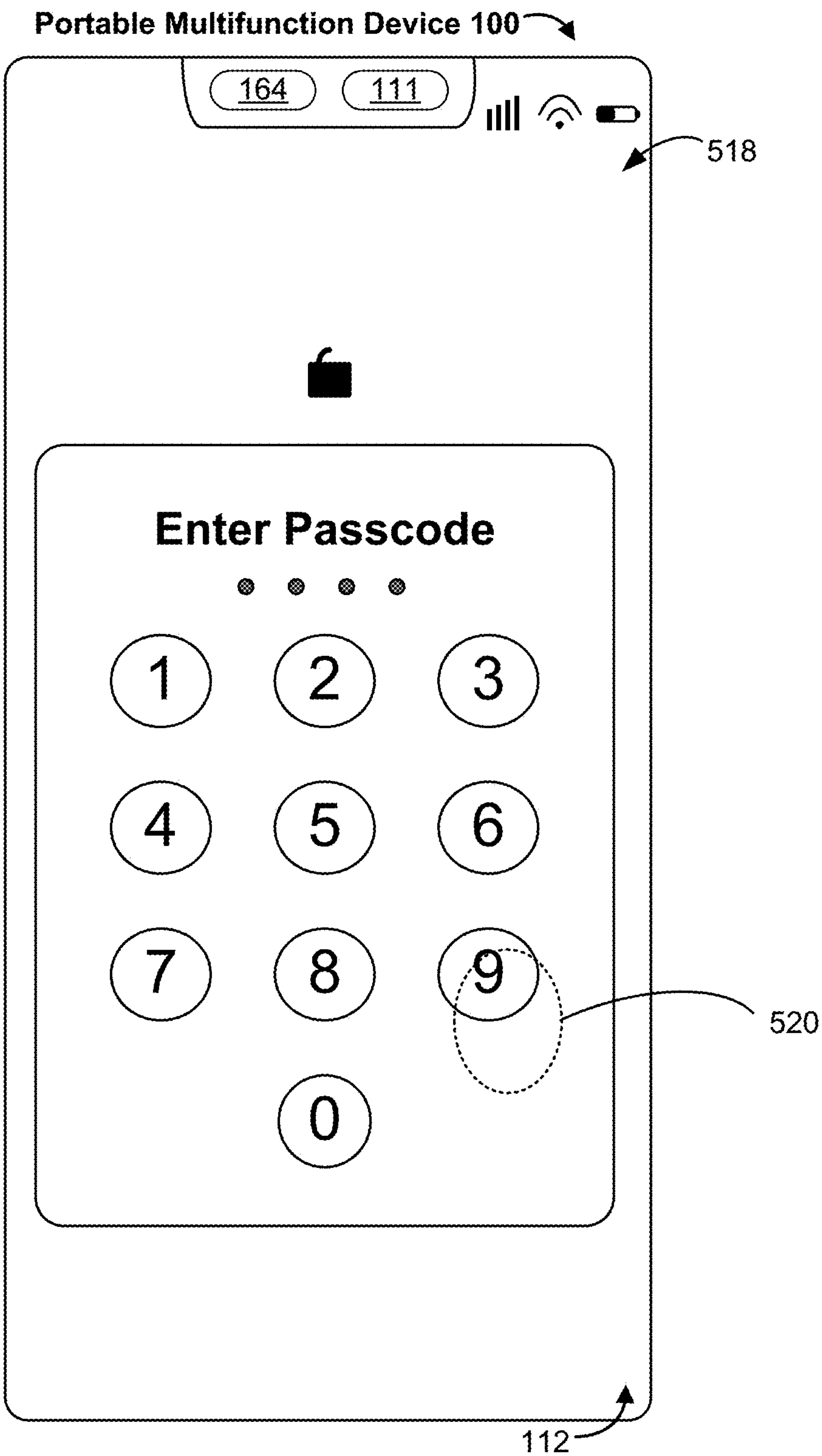
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Figure 5G

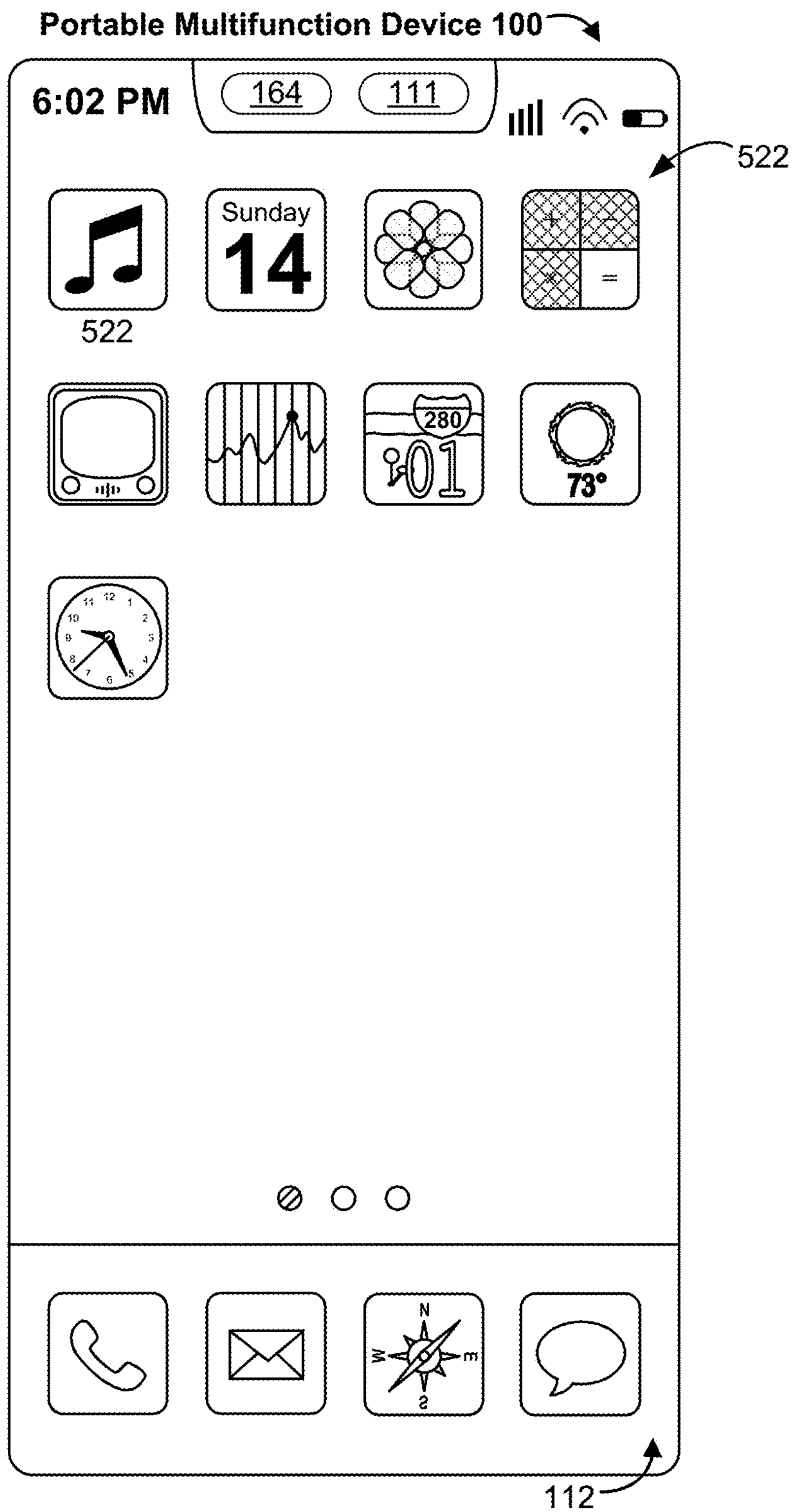

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Figure 5H

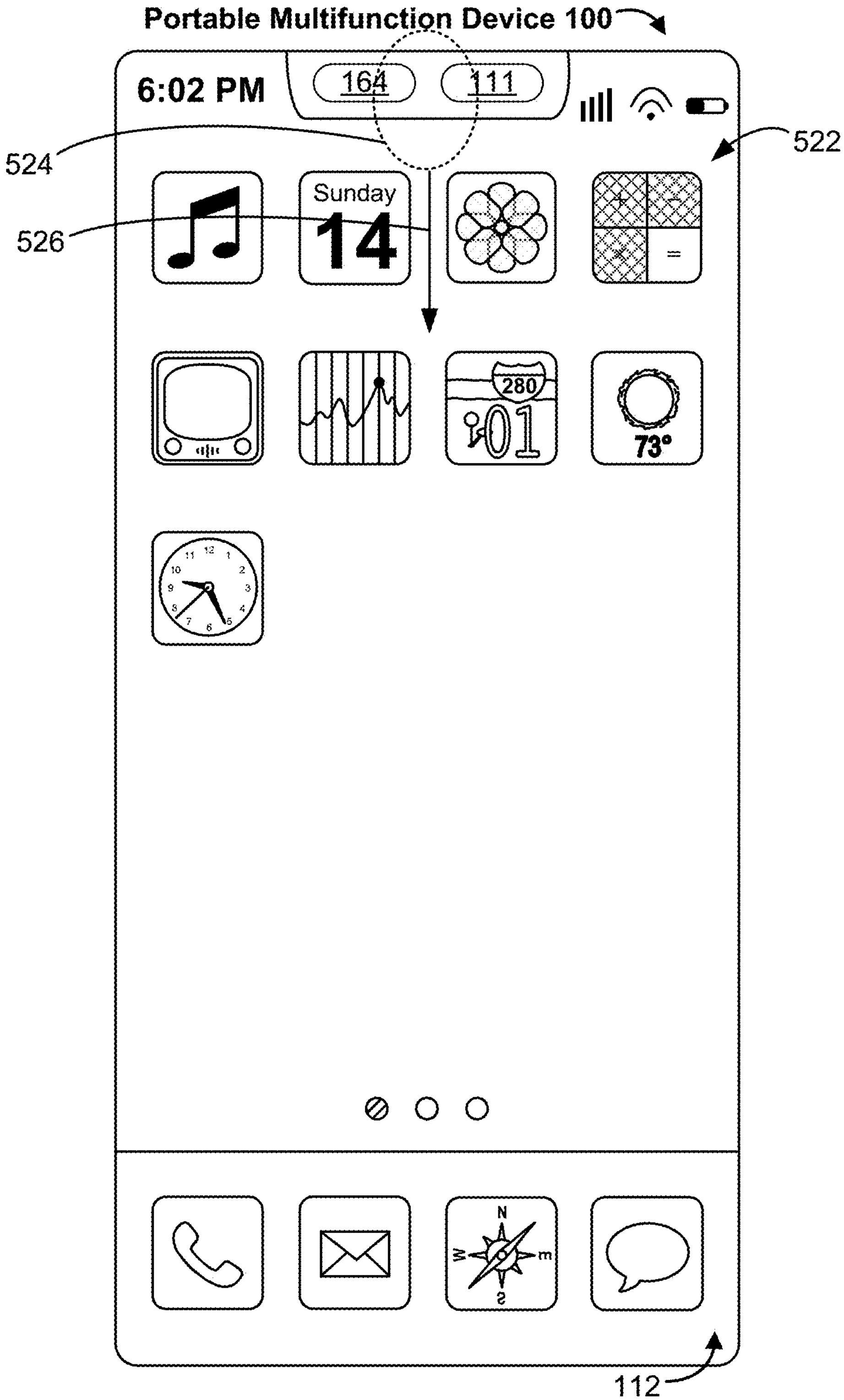
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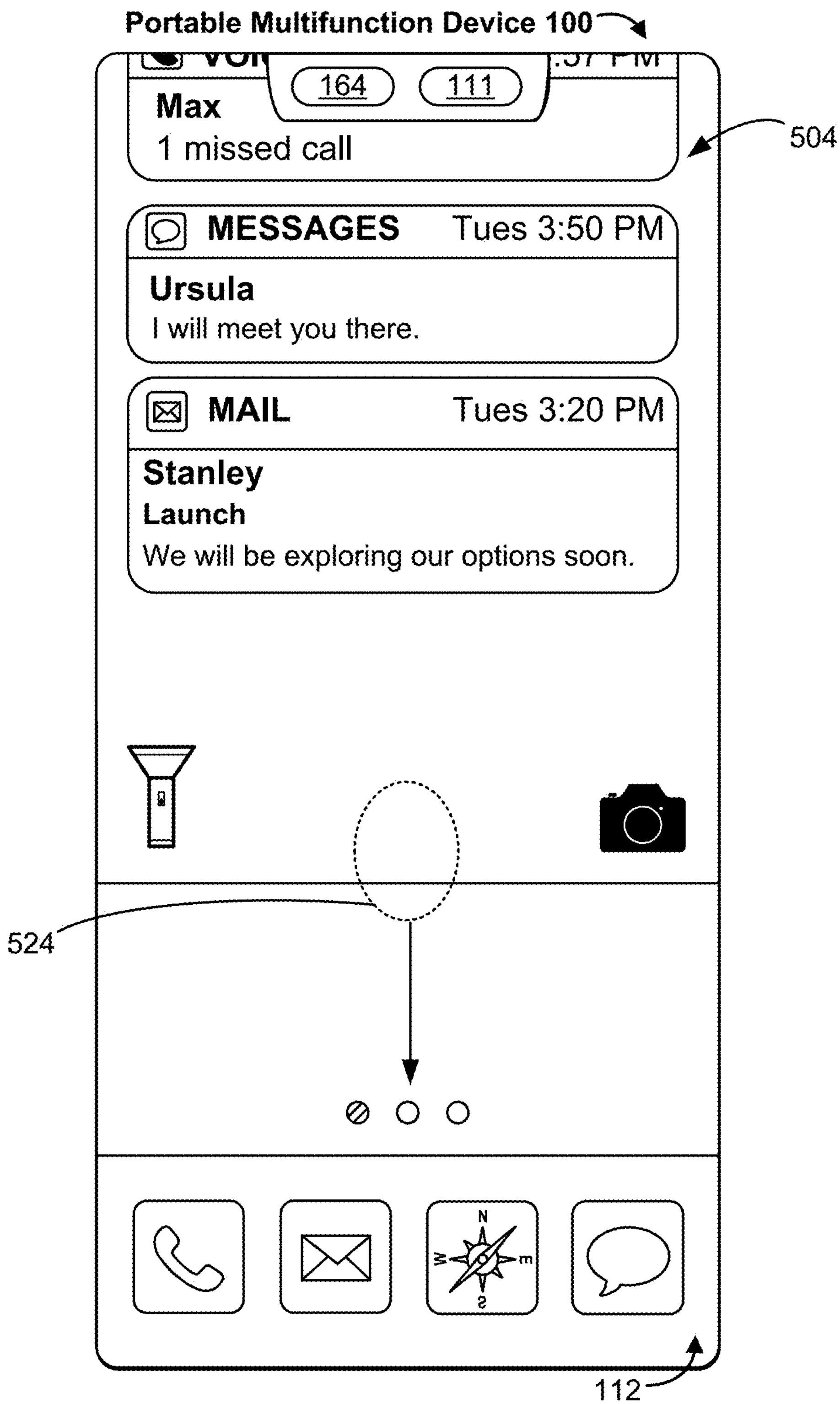
Figure 5I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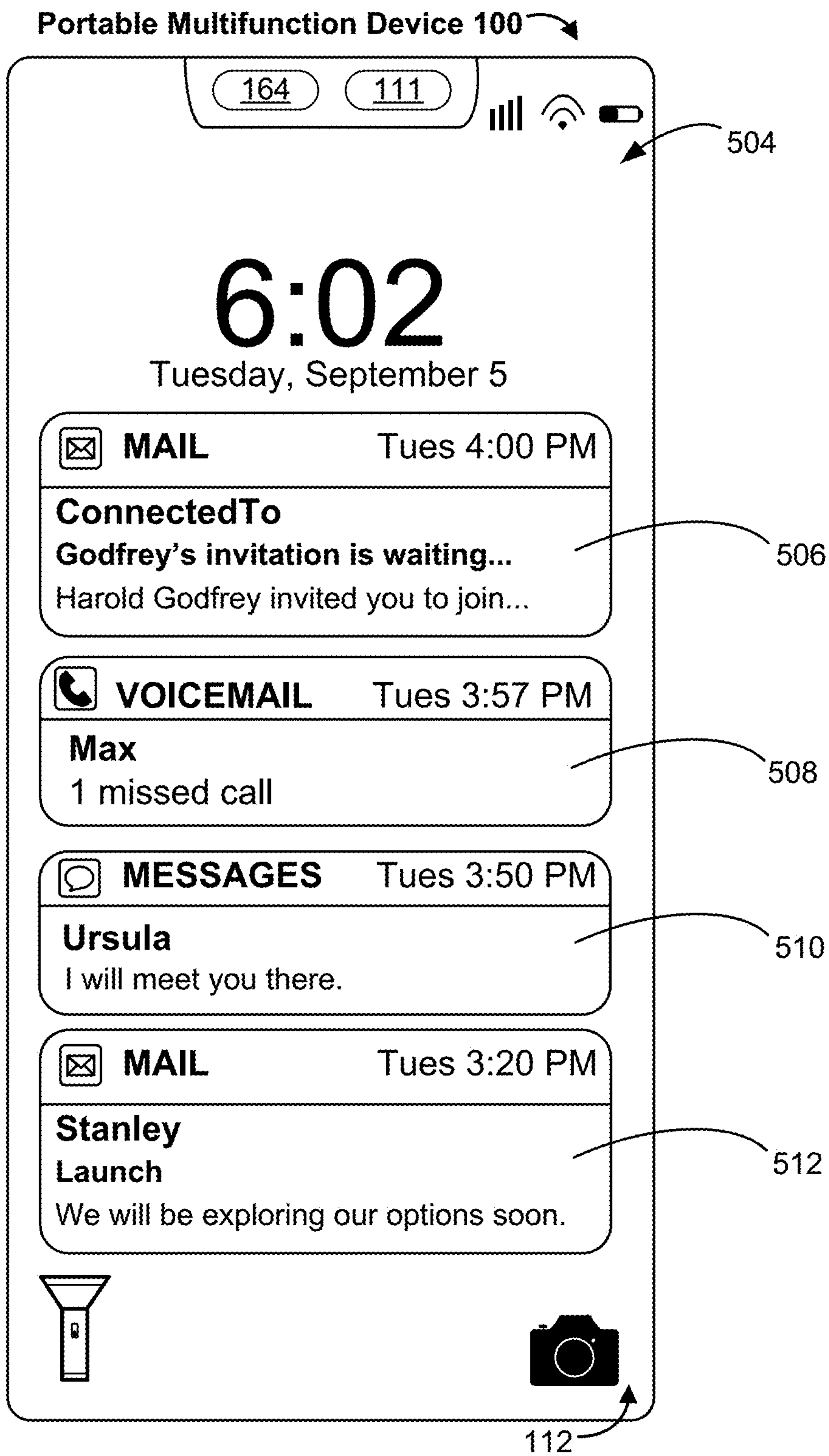
504
MESSAGES Tues 3:50 PM
Ursula
I will meet you there.
MAIL Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
524
N
112

Figure 5J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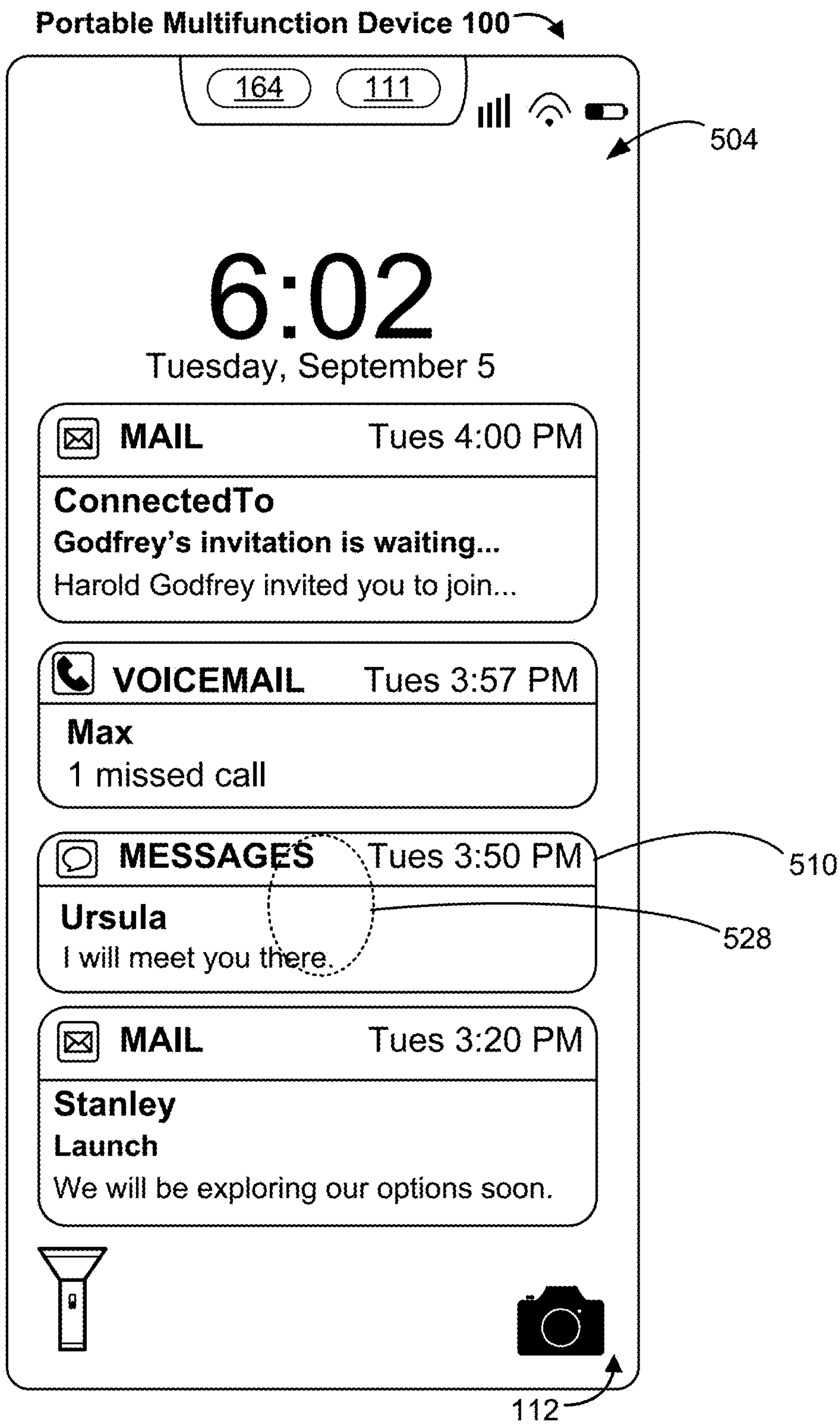
111
504
6:02
Tuesday, September 5
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
512
112

Figure 5K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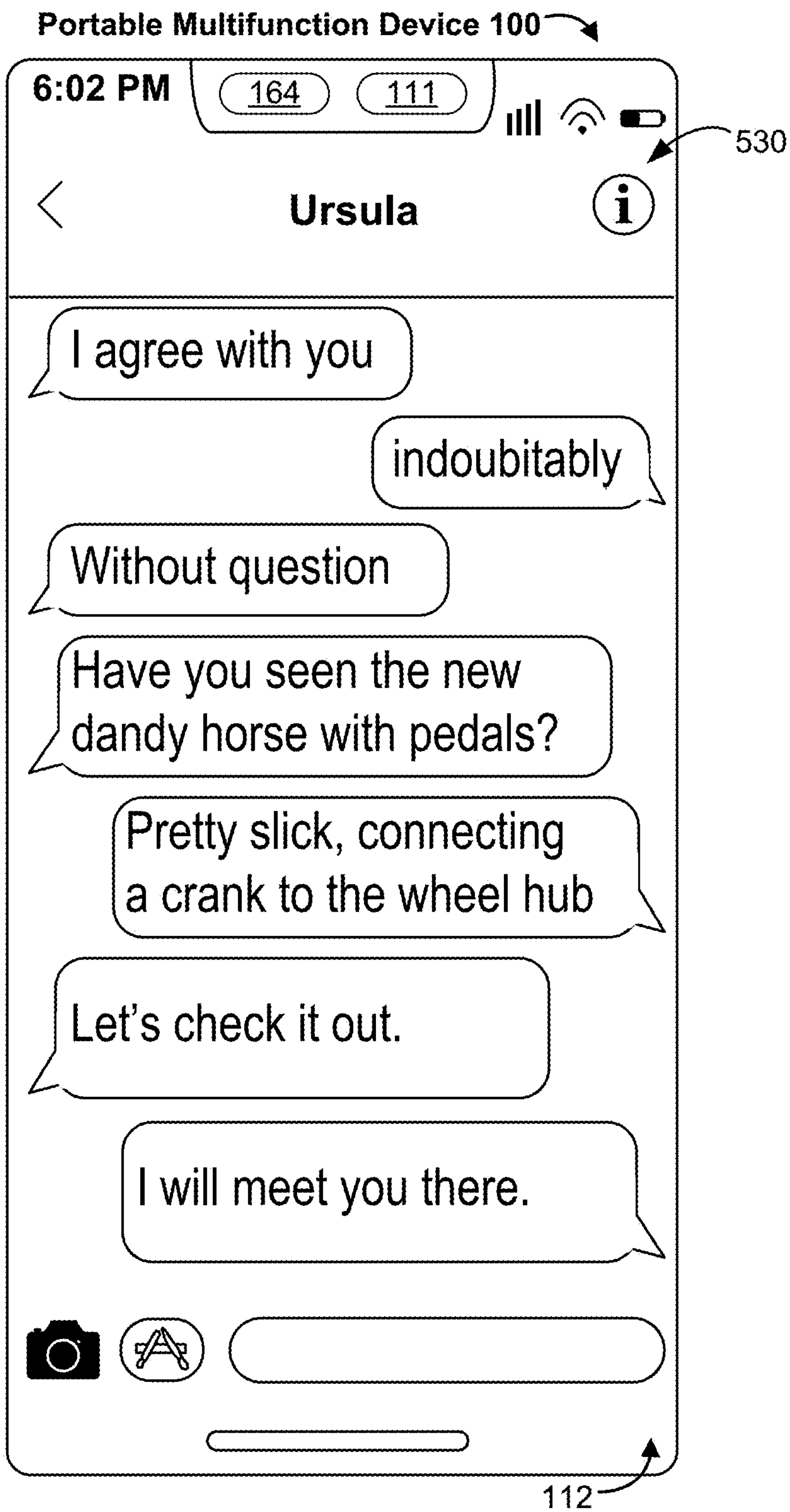
504
6:02
Tuesday, September 5
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
MESSAGES
Tues 3:50 PM
510
Ursula
I will meet you there.
528
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
112

Figure 5L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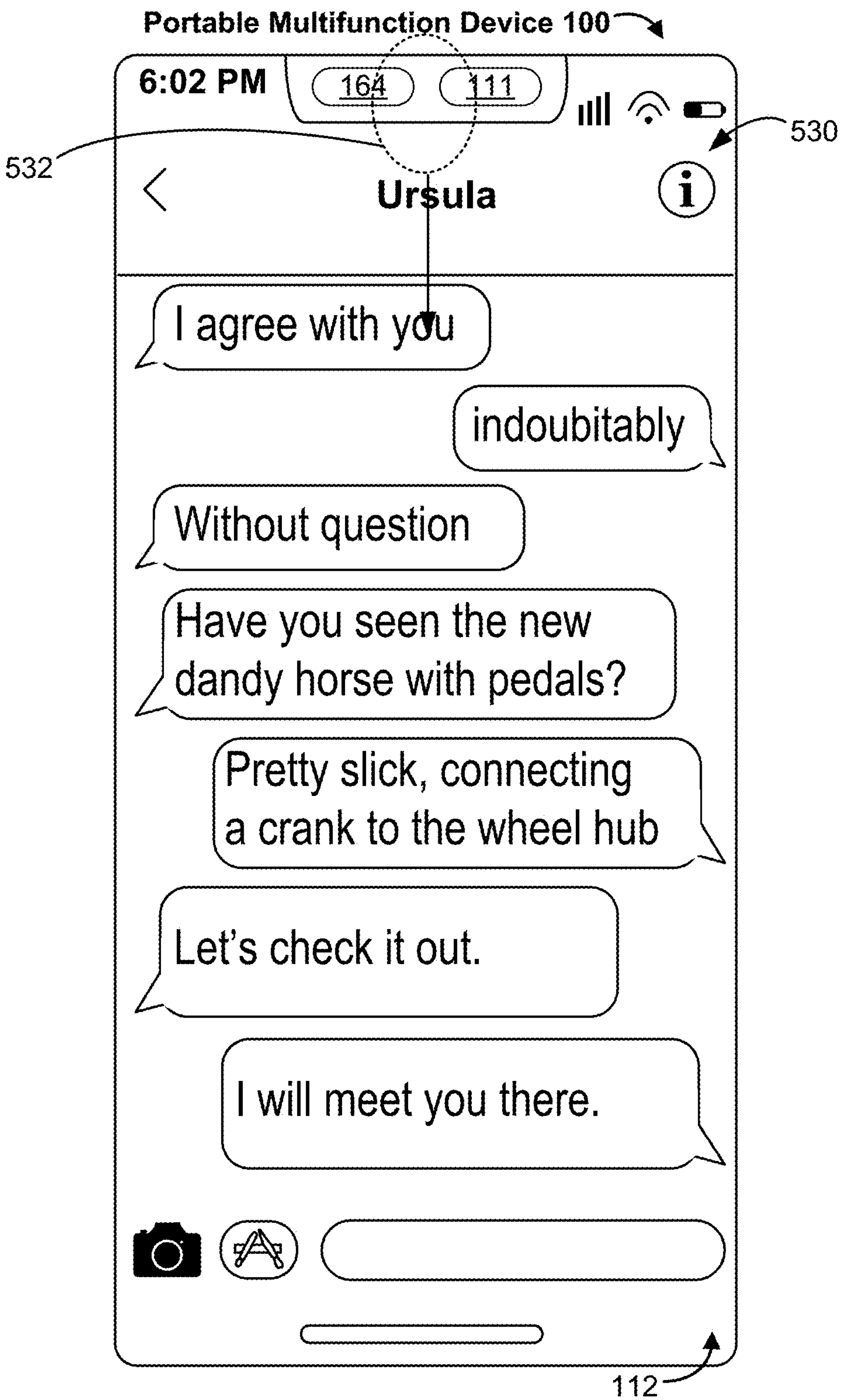
6:02 PM
164
111
530
Ursula
I agree with you
indoubitably
Without question
Have you seen the new dandy horse with pedals?
Pretty slick, connecting a crank to the wheel hub
Let's check it out.
I will meet you there.
112

Figure 5M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111
532
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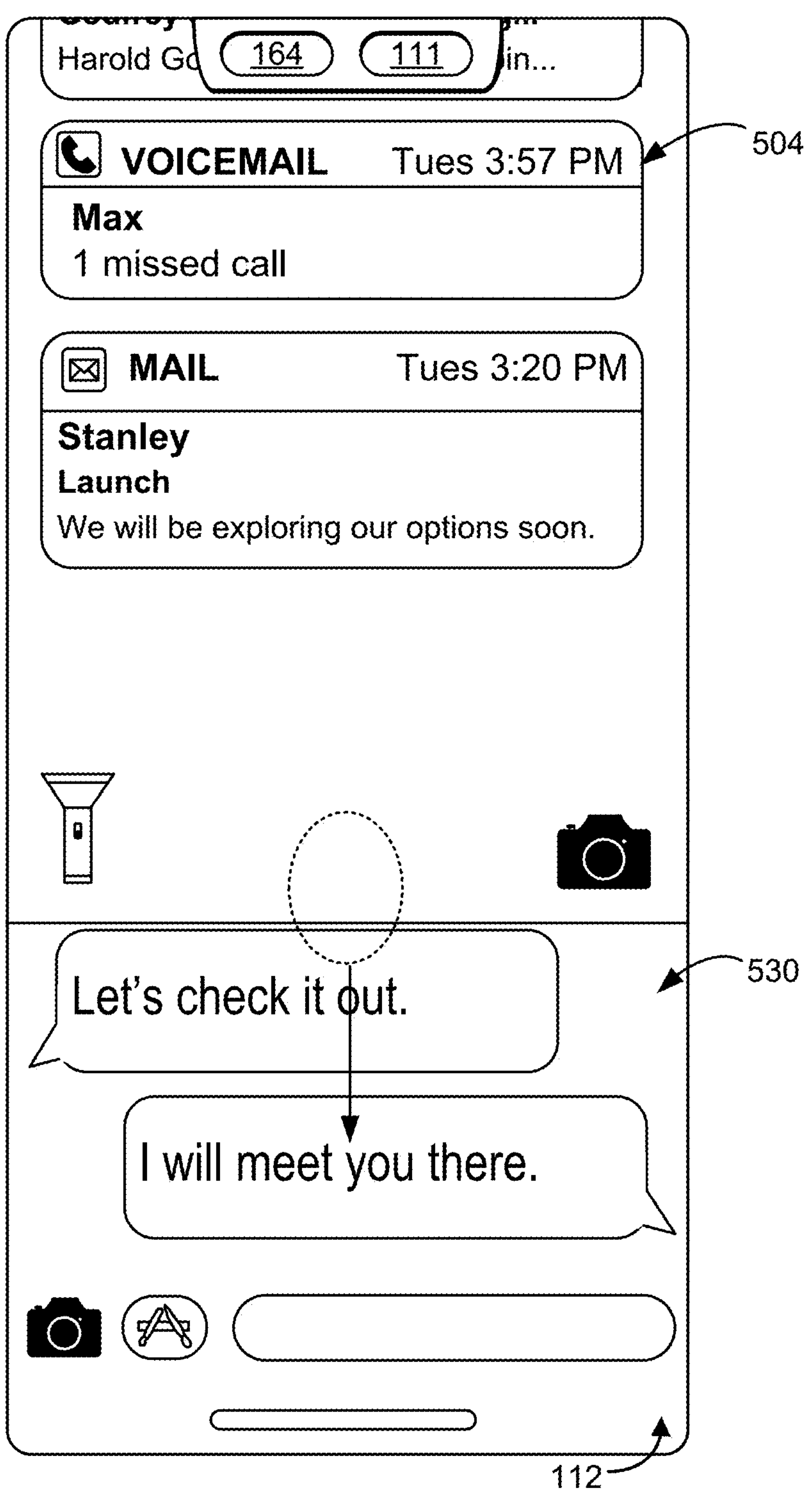
Ursula
I agree with you
indoubitably
Without question
Have you seen the new dandy horse with pedals?
Pretty slick, connecting a crank to the wheel hub
Let's check it out.
I will meet you there.
112

Figure 5N


Harold Go
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in...
VOICEMAIL Tues 3:57 PM
Max
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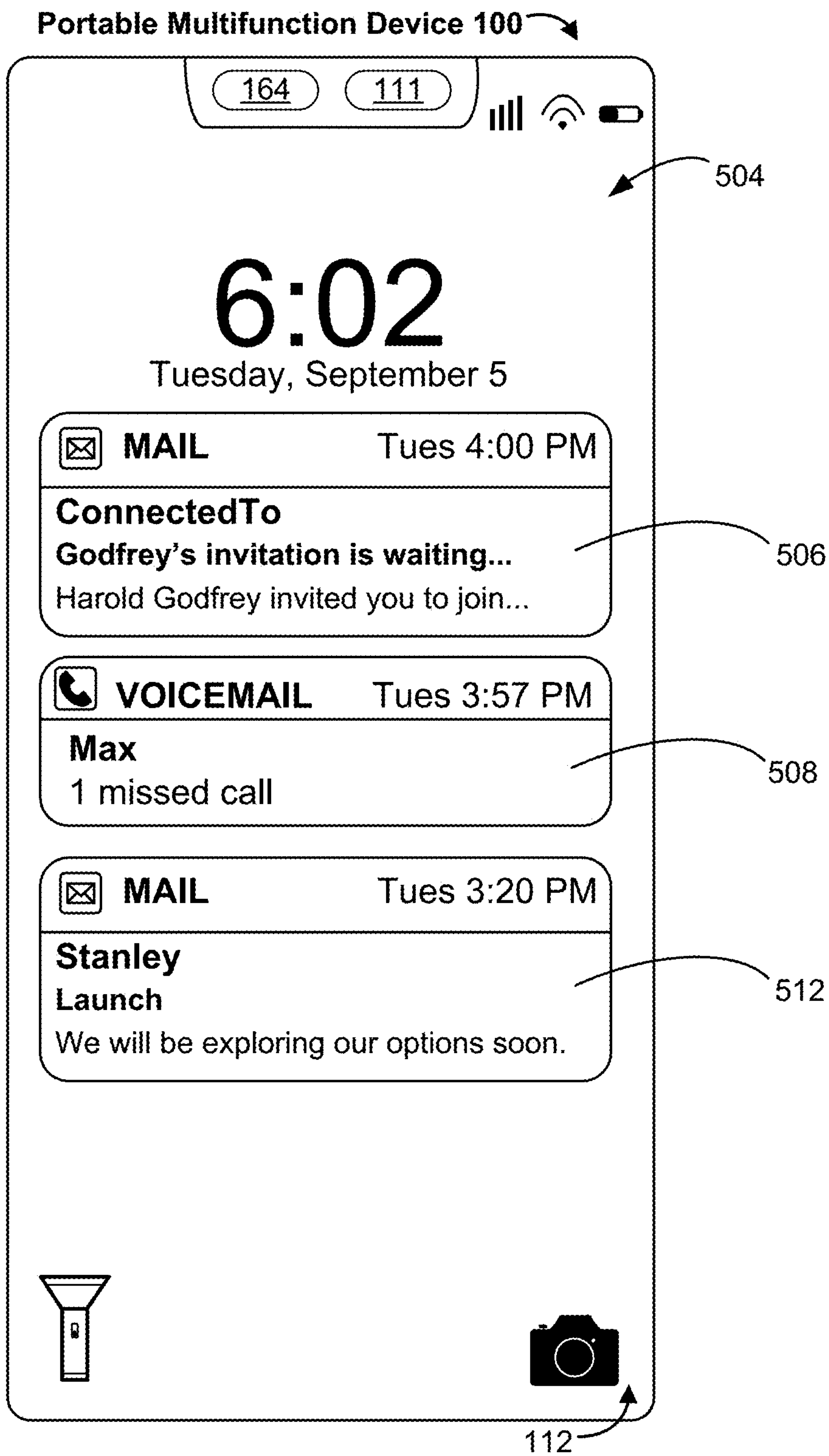
MAIL Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
Let's check it out.
530
I will meet you there.
112

Figure 5O


Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
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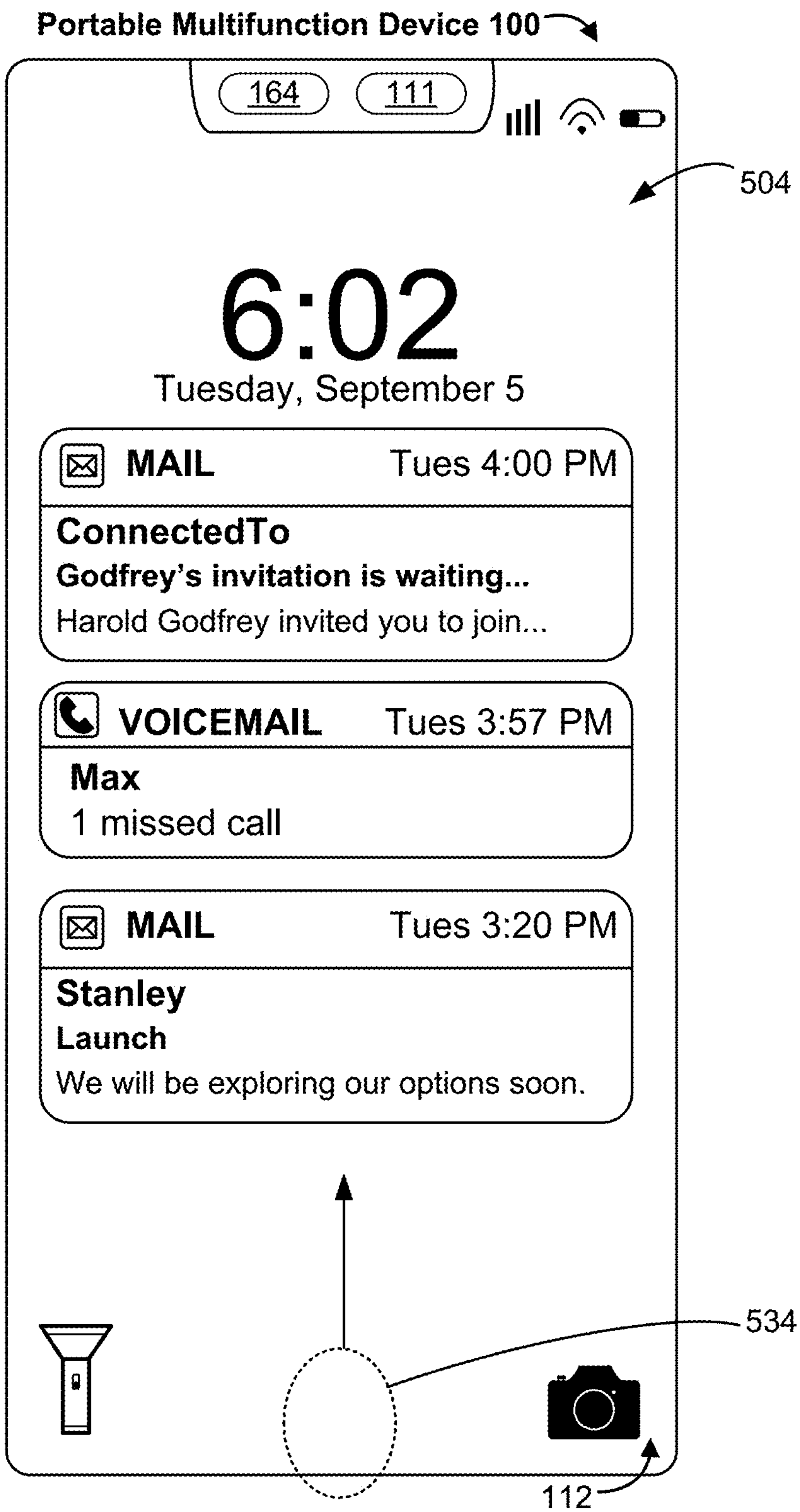
1 missed call
508
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
512
112

Figure 5P


Portable Multifunction Device 100
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ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
VOICEMAIL
Tues 3:57 PM
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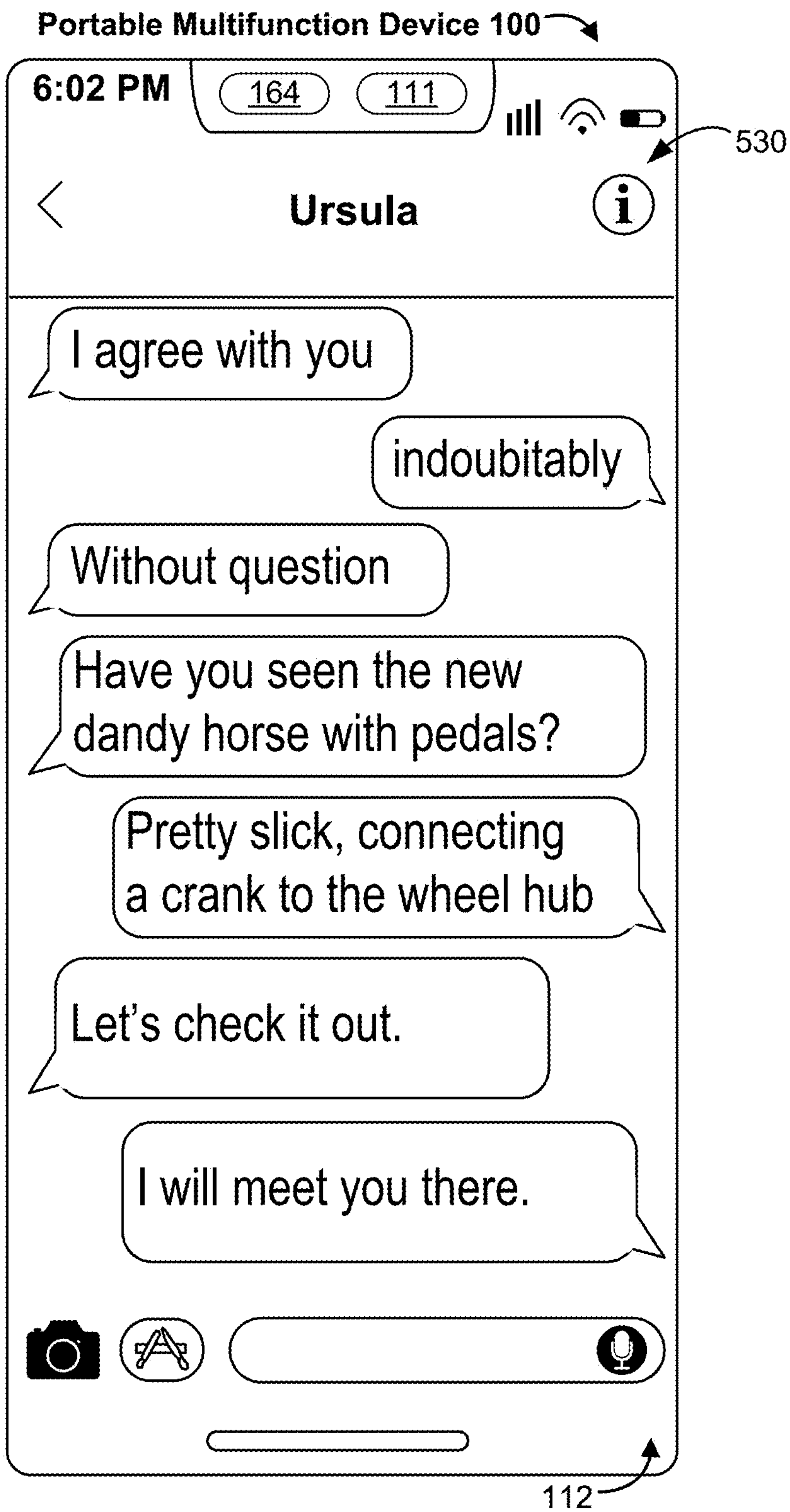
1 missed call
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
534
112

Figure 5Q


Portable Multifunction Device 100
6:02 PM
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111
530
Ursula
I agree with you
indoubitably
Without question
Have you seen the new dandy horse with pedals?
Pretty slick, connecting a crank to the wheel hub
Let's check it out.
I will meet you there.
112

Figure 5R

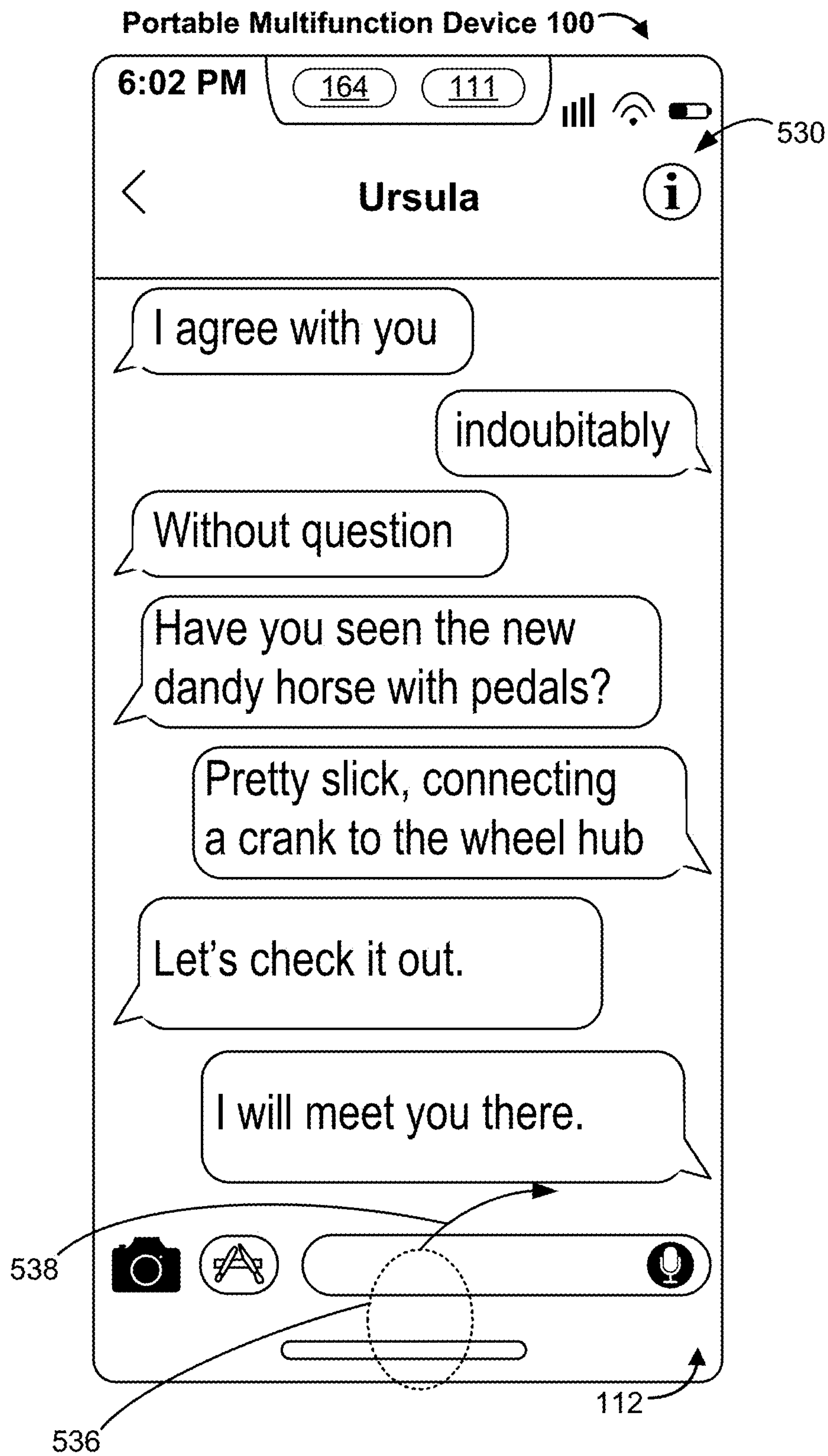
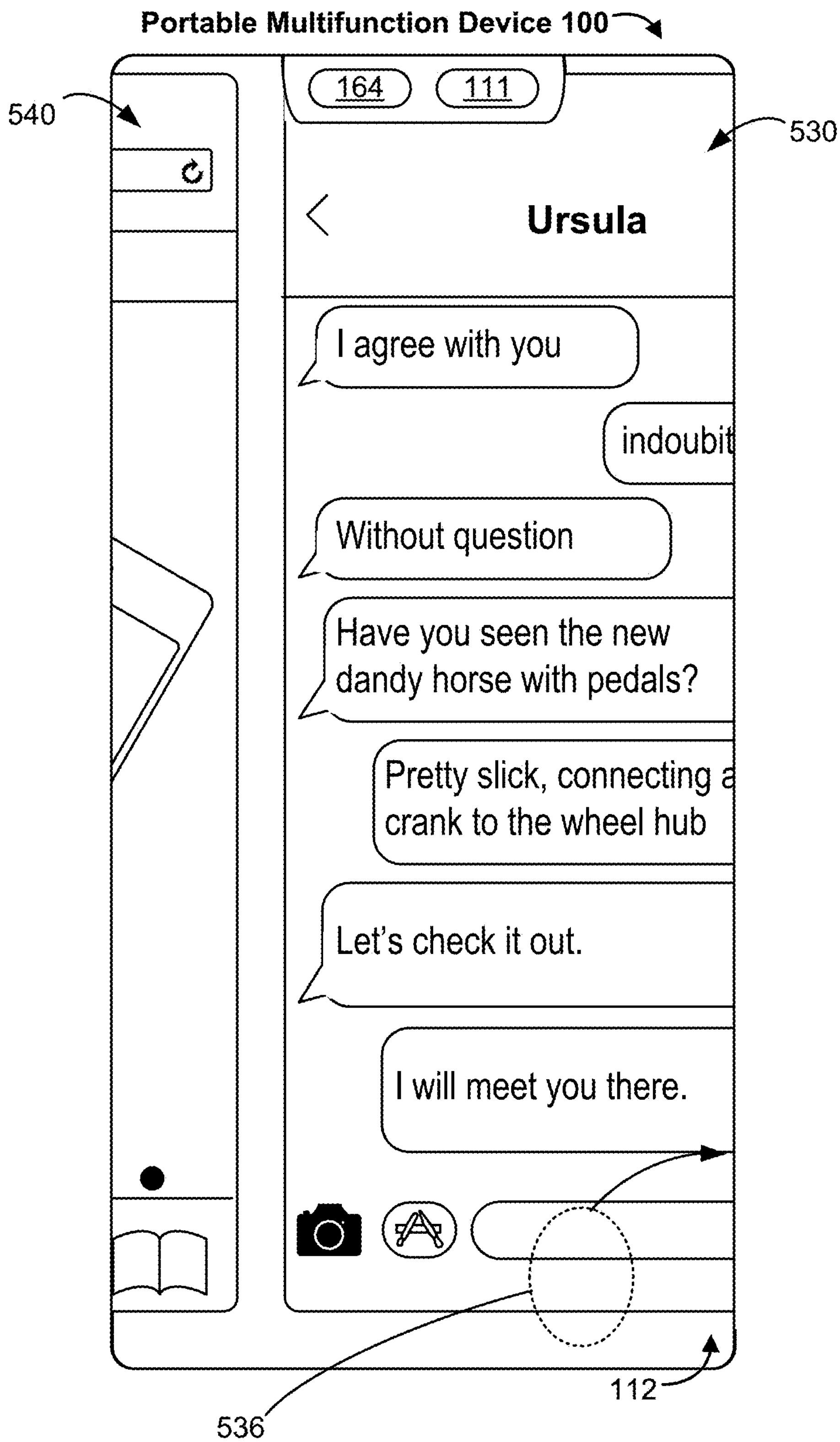

Portable Multifunction Device 100
6:02 PM
164
111
530
Ursula
I agree with you
indoubitably
Without question
Have you seen the new dandy horse with pedals?
Pretty slick, connecting a crank to the wheel hub
Let's check it out.
I will meet you there.
538
112
536

Figure 5S



Portable Multifunction Device 100
540
530
164
111
Ursula
I agree with you
indoubit
Without question
Have you seen the new dandy horse with pedals?
Pretty slick, connecting a crank to the wheel hub
Let's check it out.
I will meet you there.
536
112

Figure 5T

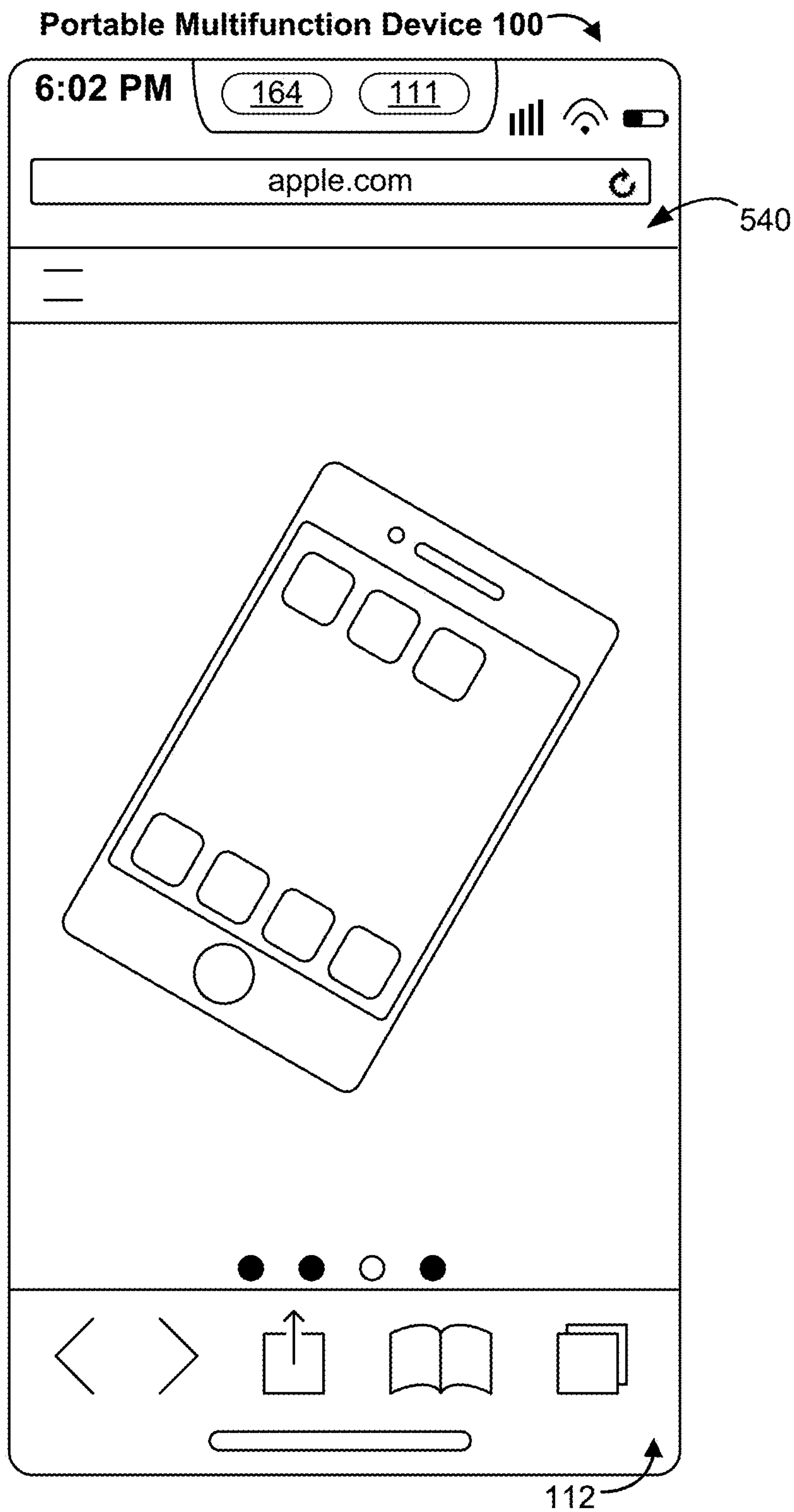

Portable Multifunction Device 100
6:02 PM
164
111
apple.com
540
112

Figure 5U

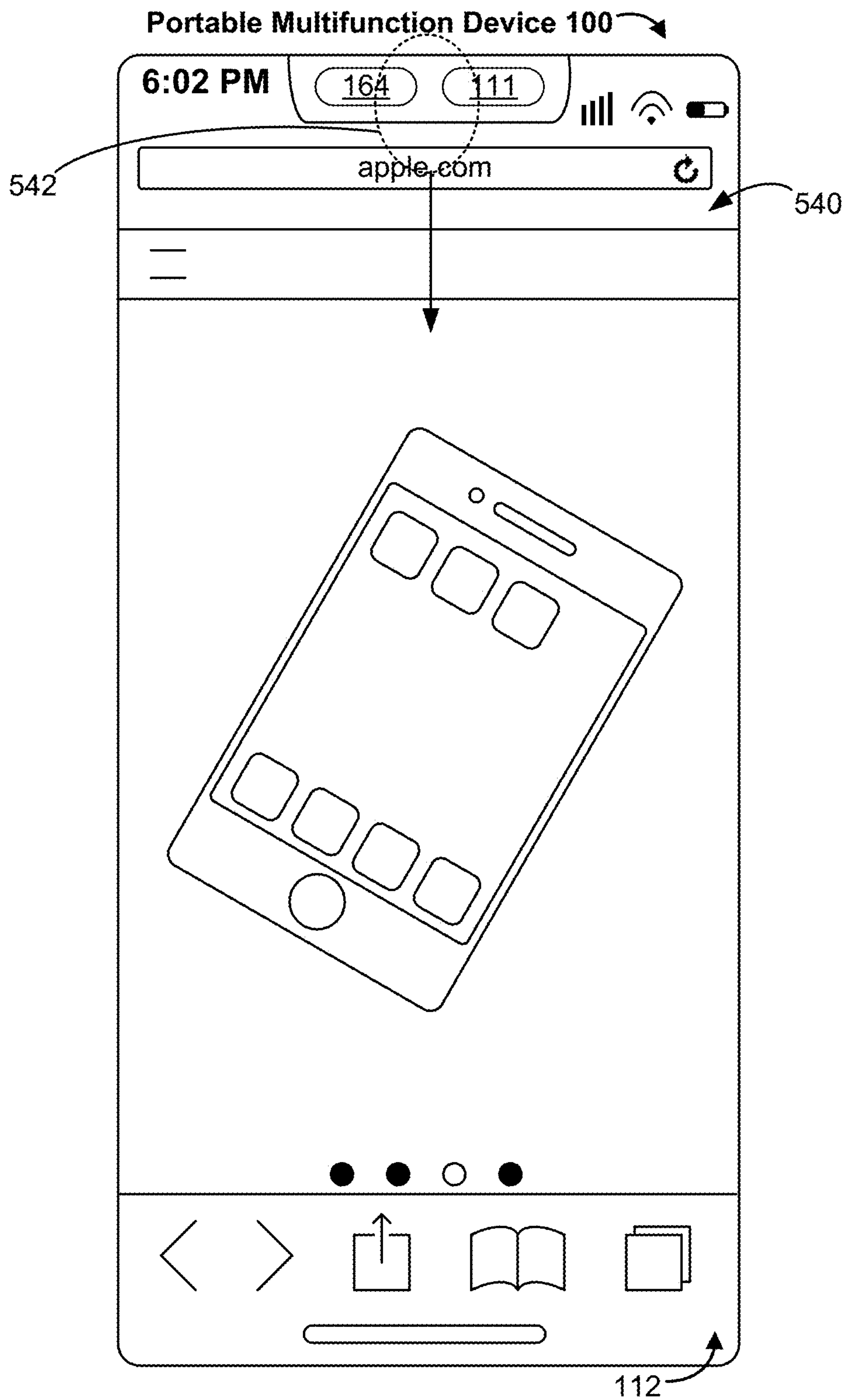
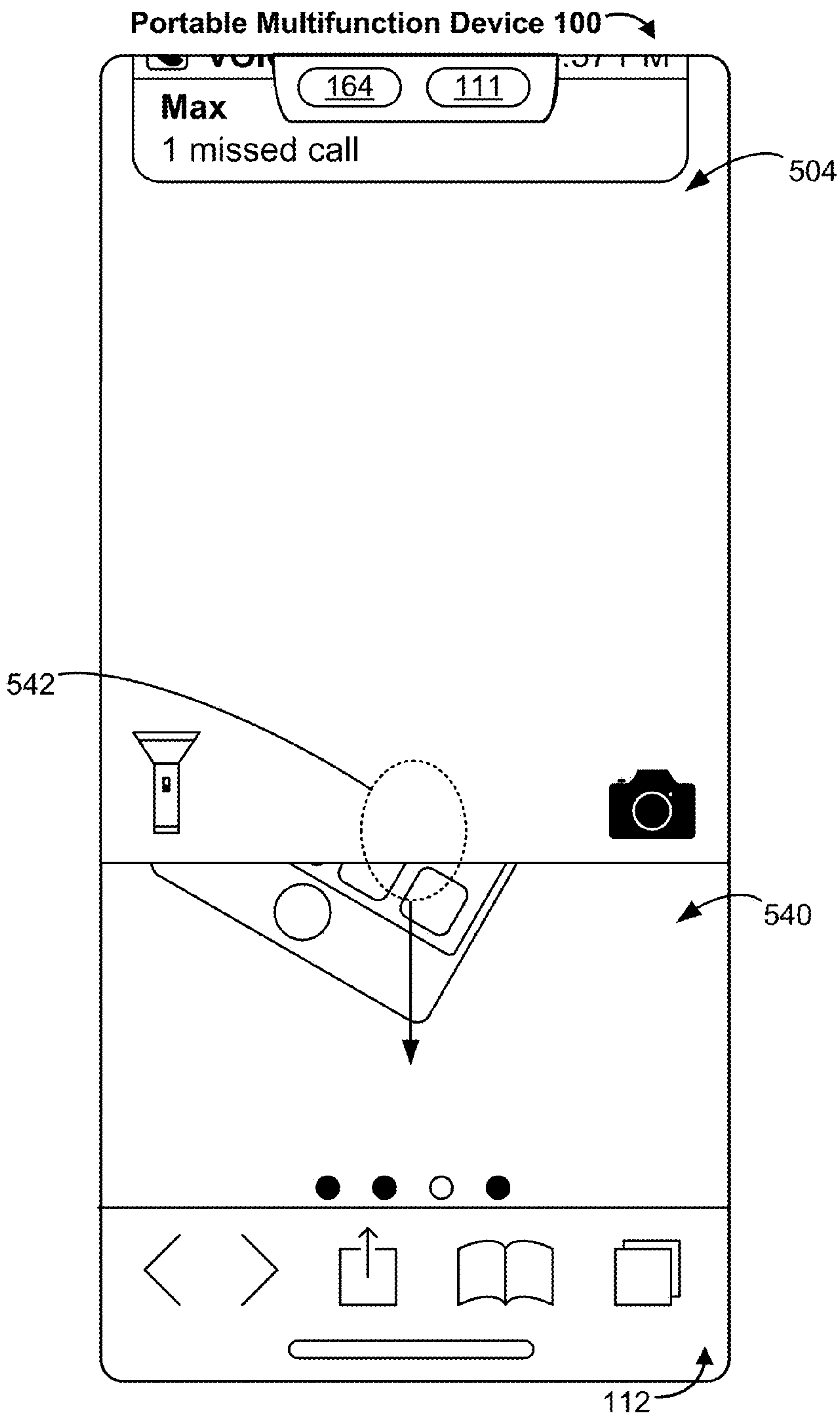
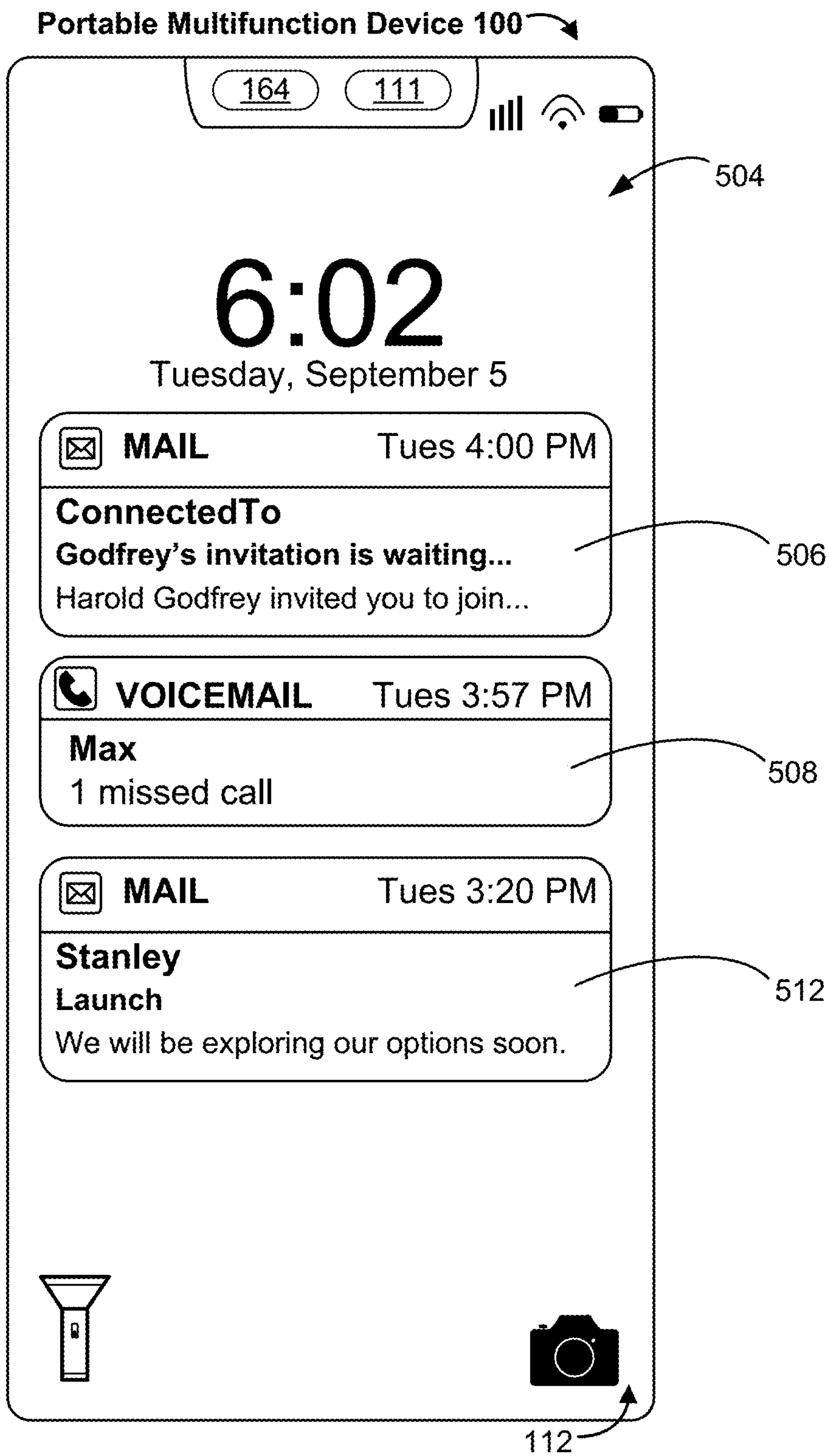

Portable Multifunction Device 100
6:02 PM
164
111
542
apple.com
540
112

Figure 5V



Portable Multifunction Device 100
164
111
Max
1 missed call
504
542
540
112

Figure 5W



Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
512
112

Figure 5X

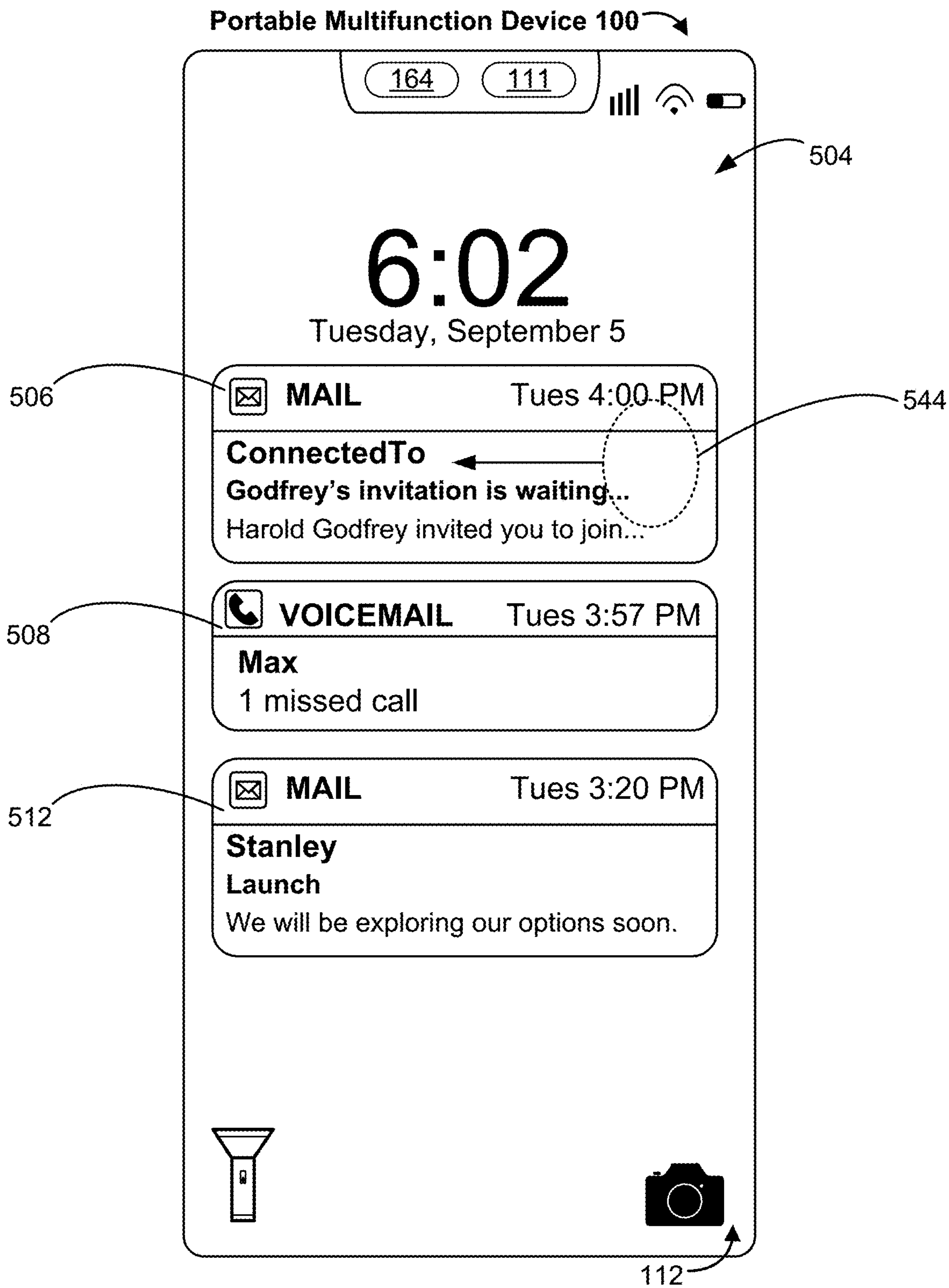
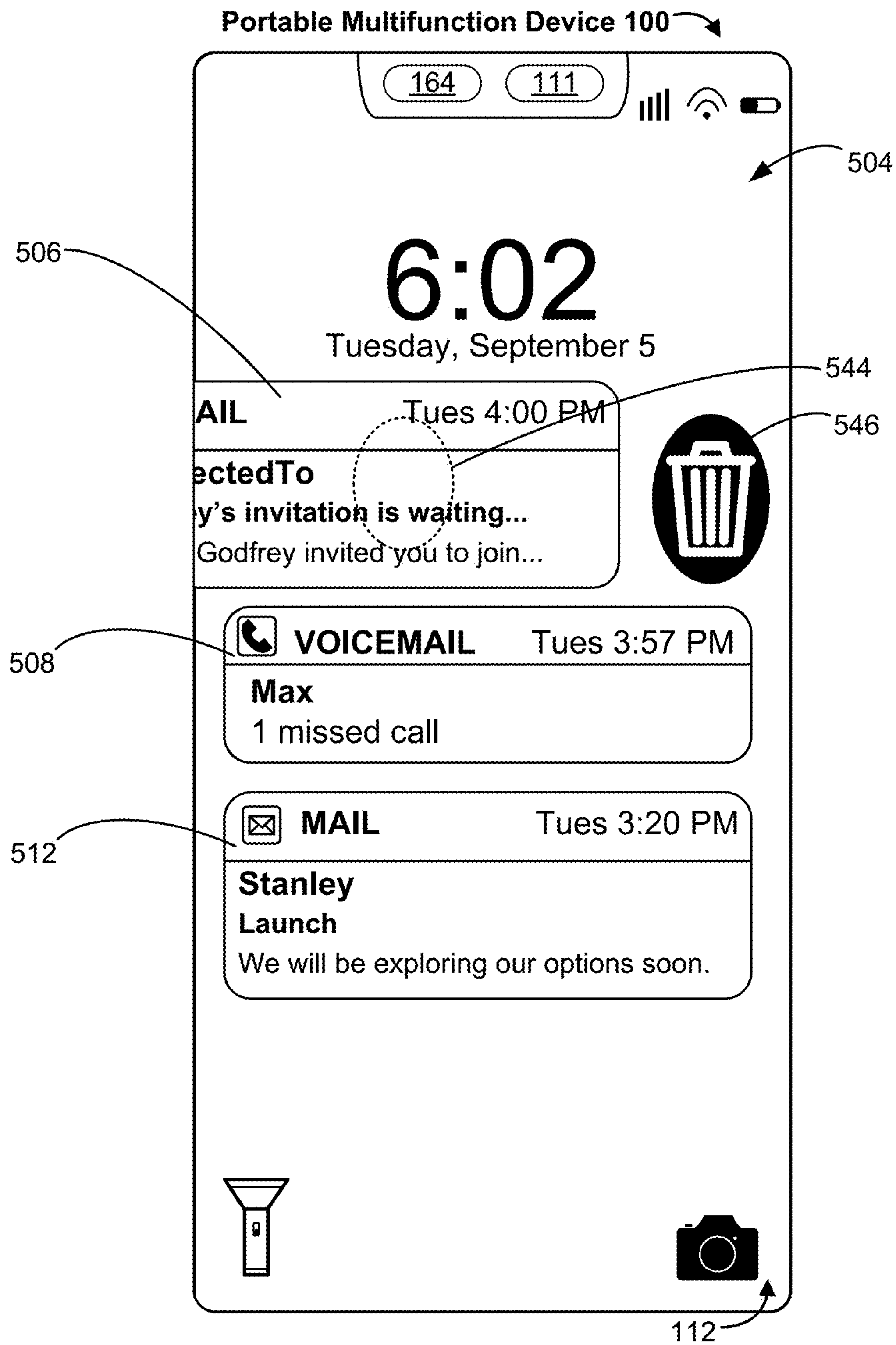
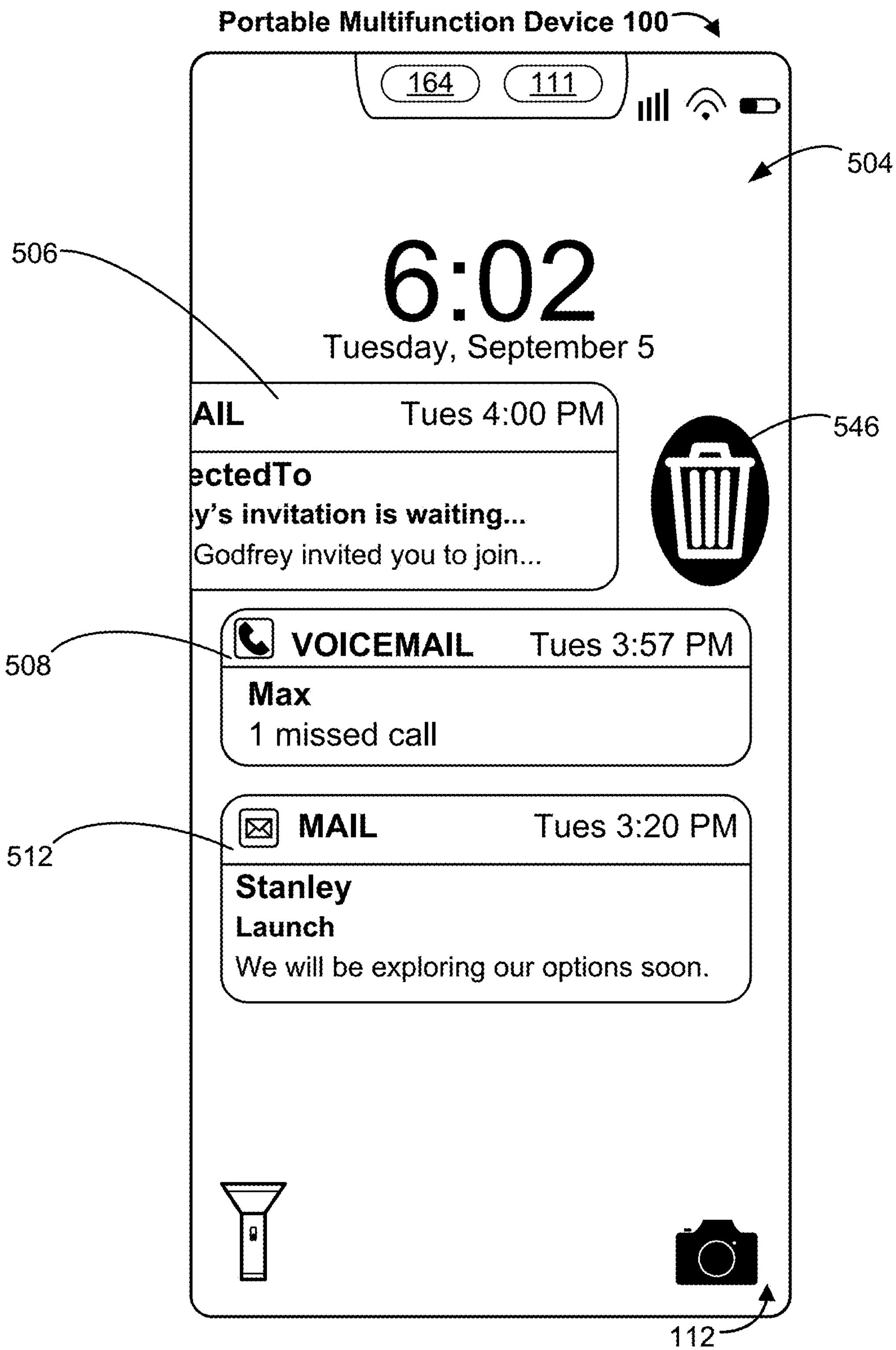

Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
506
MAIL
Tues 4:00 PM
544
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
112

Figure 5Y



Portable Multifunction Device 100
164
111
504
506
6:02
Tuesday, September 5
544
AIL
Tues 4:00 PM
546
ectedTo
y's invitation is waiting...
Godfrey invited you to join...
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
112

Figure 5Z



Portable Multifunction Device 100
164
111
504
506
6:02
Tuesday, September 5
AIL
Tues 4:00 PM
ectedTo
y's invitation is waiting...
Godfrey invited you to join...
546
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
112

Figure 5AA

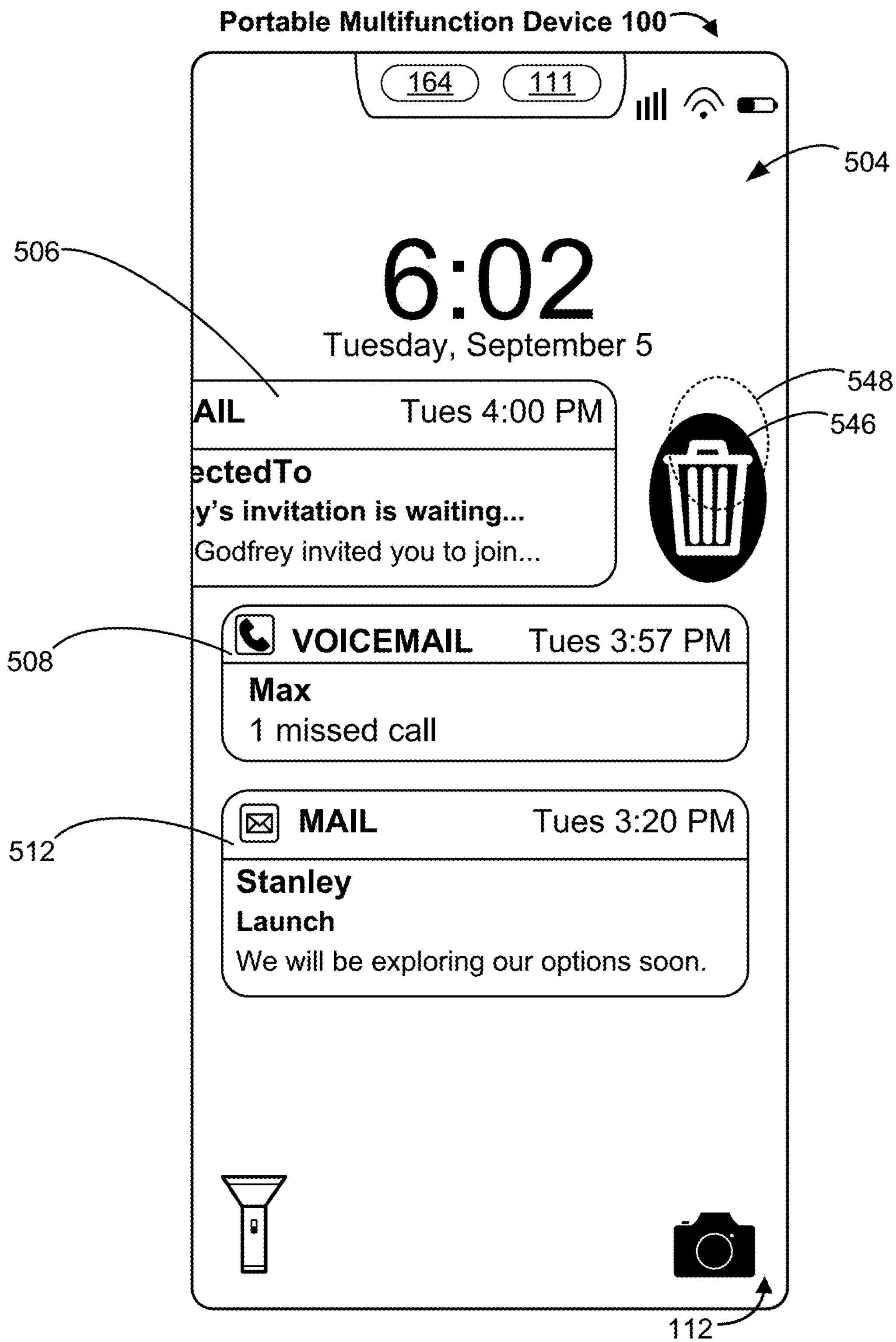

Portable Multifunction Device 100
164
111
504
506
6:02
Tuesday, September 5
548
546
AIL
Tues 4:00 PM
ectedTo
y's invitation is waiting...
Godfrey invited you to join...
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
112

Figure 5AB

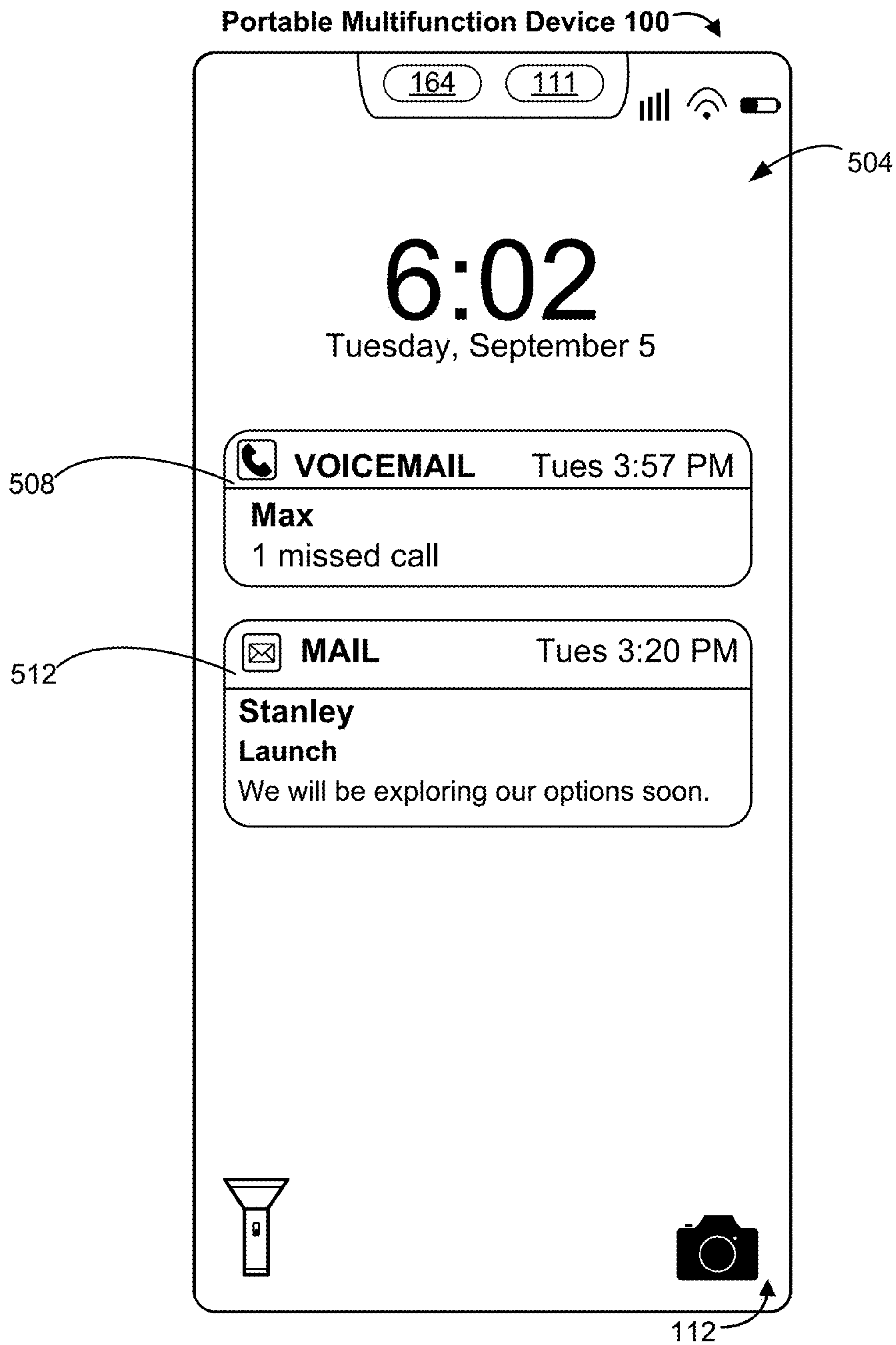

Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
112

Figure 5AC

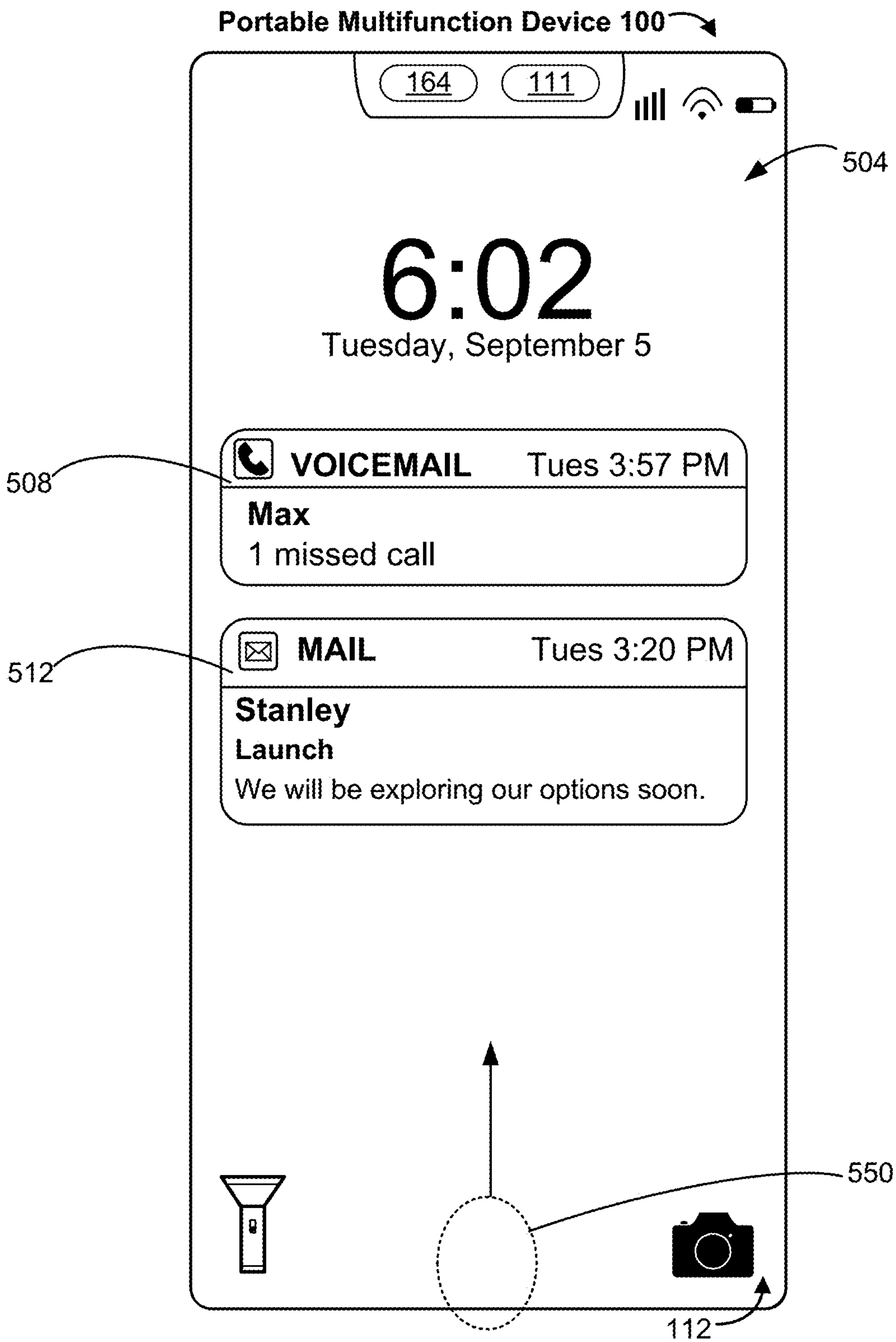

Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
550
112

Figure 5AD

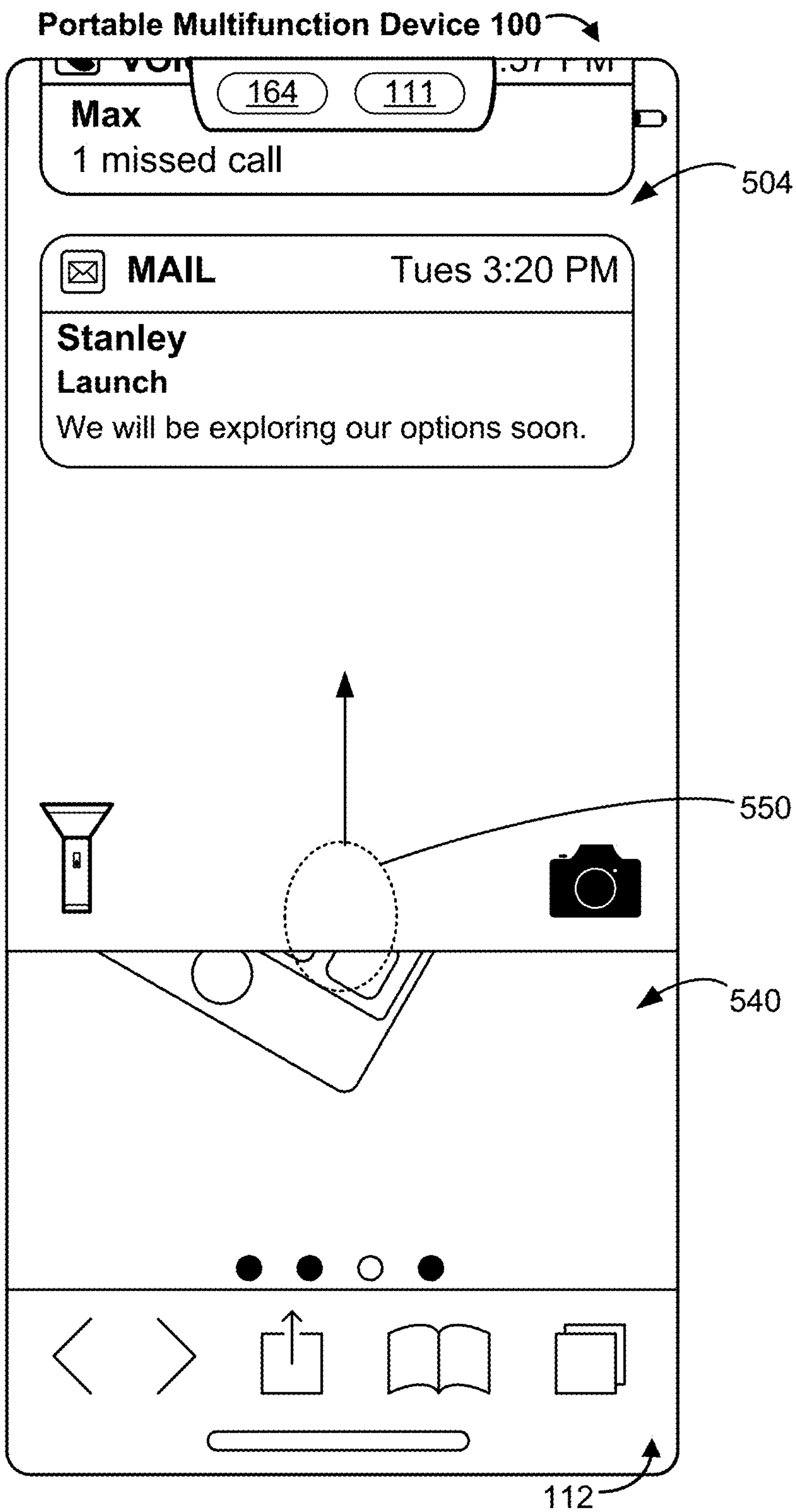
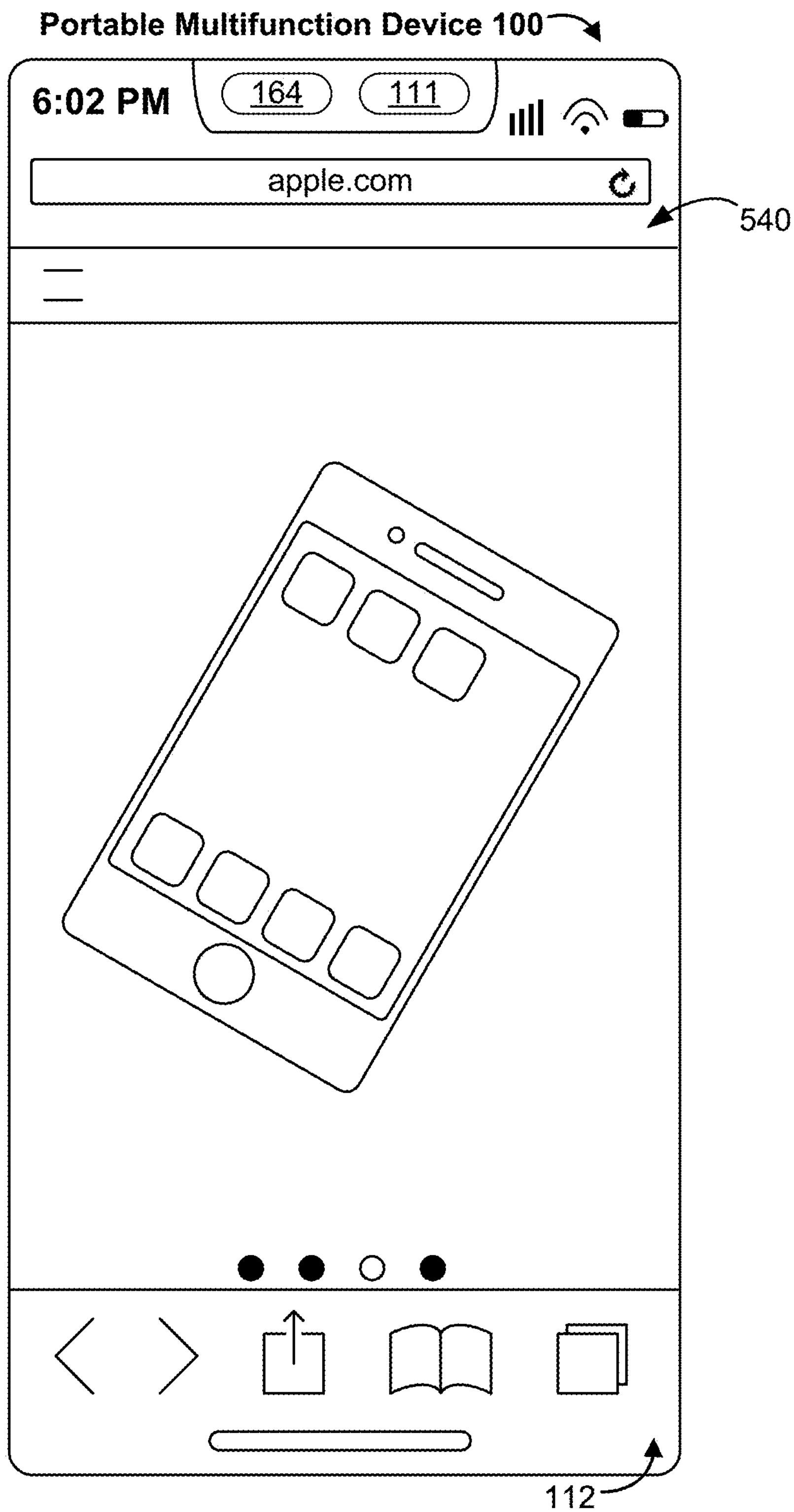

Portable Multifunction Device 100
164
111
Max
1 missed call
504
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
550
540
112

Figure 5AE



Portable Multifunction Device 100
6:02 PM
164
111
apple.com
540
112

Figure 5AF

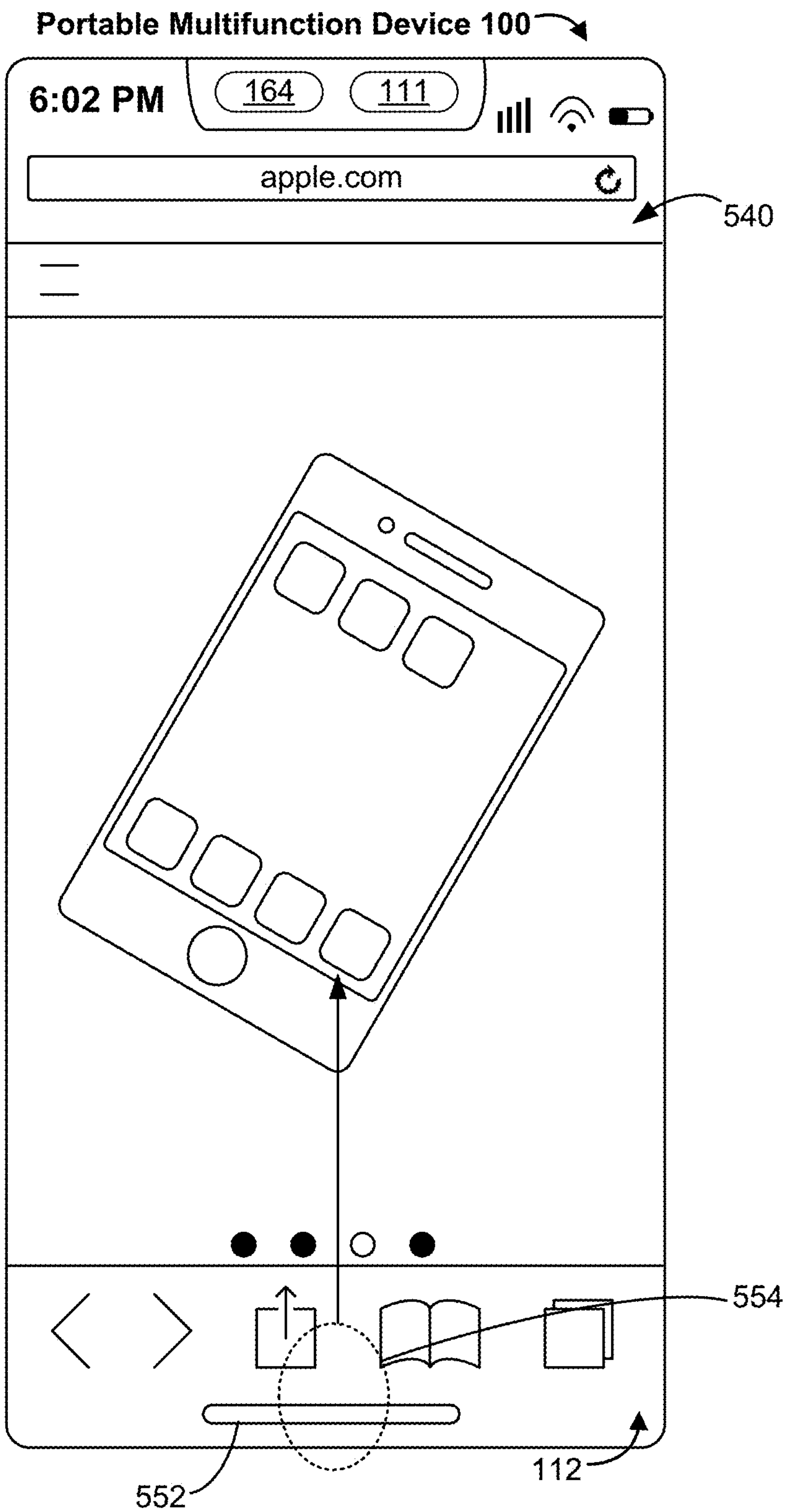

Portable Multifunction Device 100
6:02 PM
164
111
apple.com
540
554
552
112

Figure 5AG

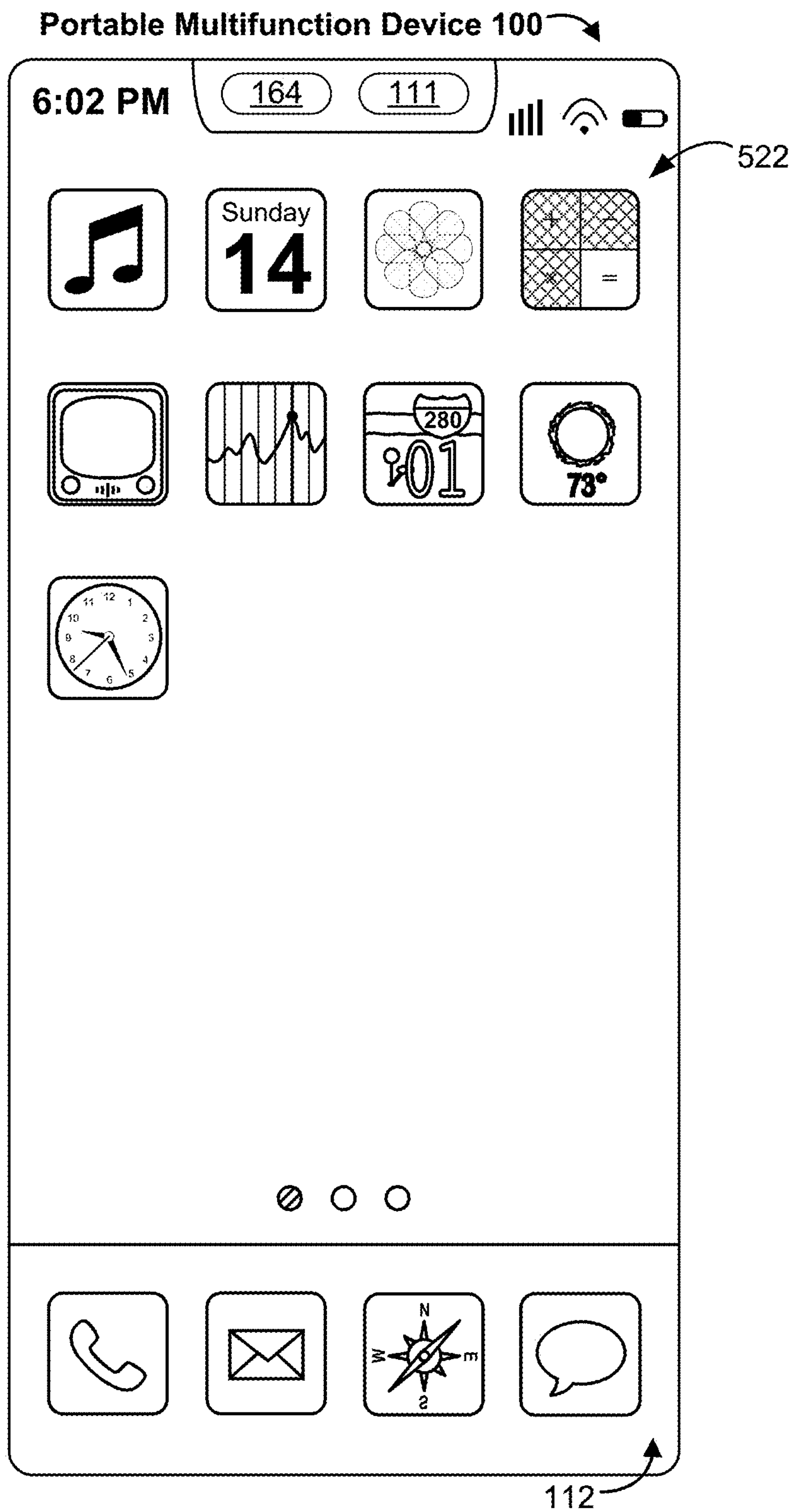

Portable Multifunction Device 100
6:02 PM
164
111
522
Sunday
14
280
73°
112

Figure 5AH

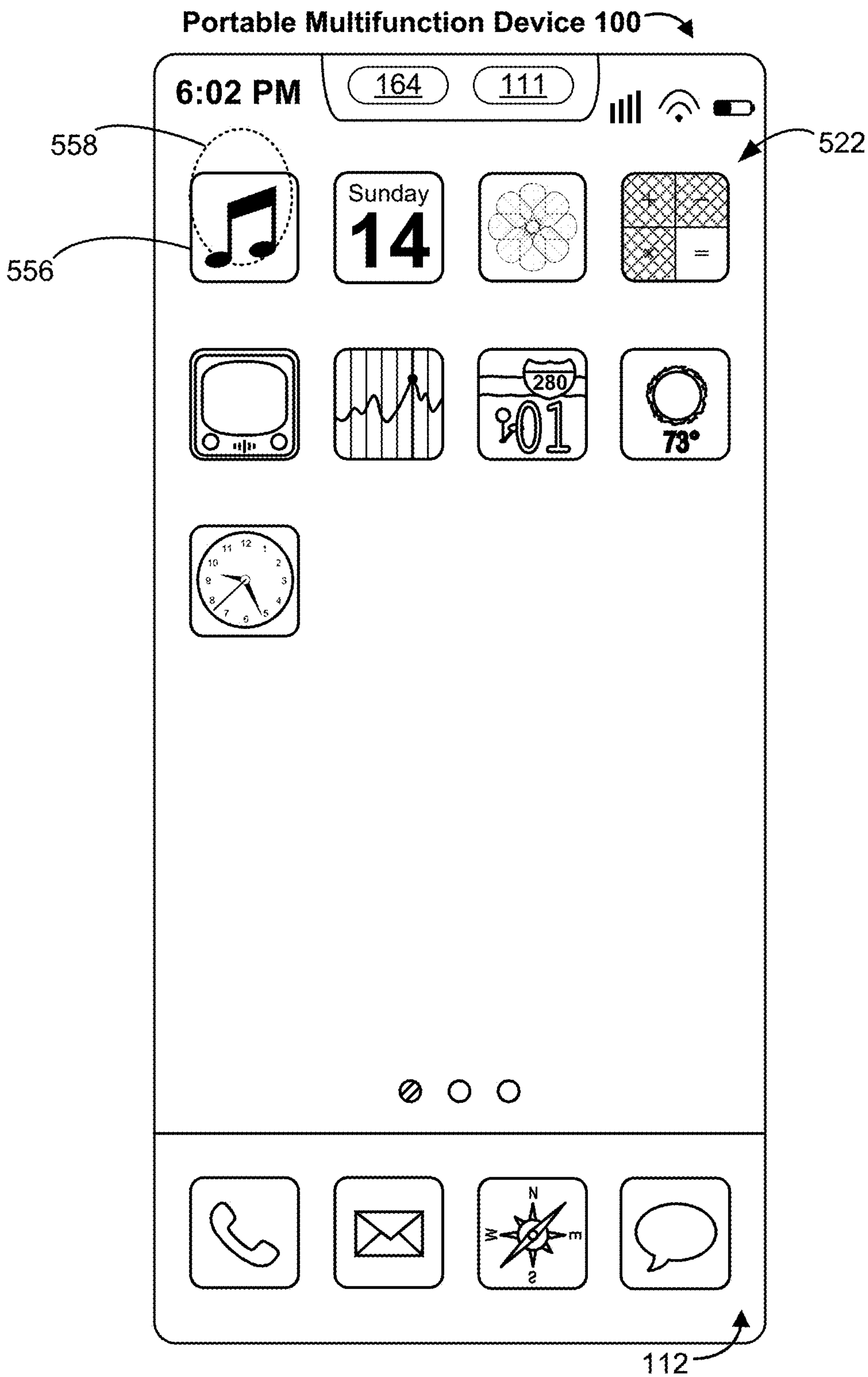
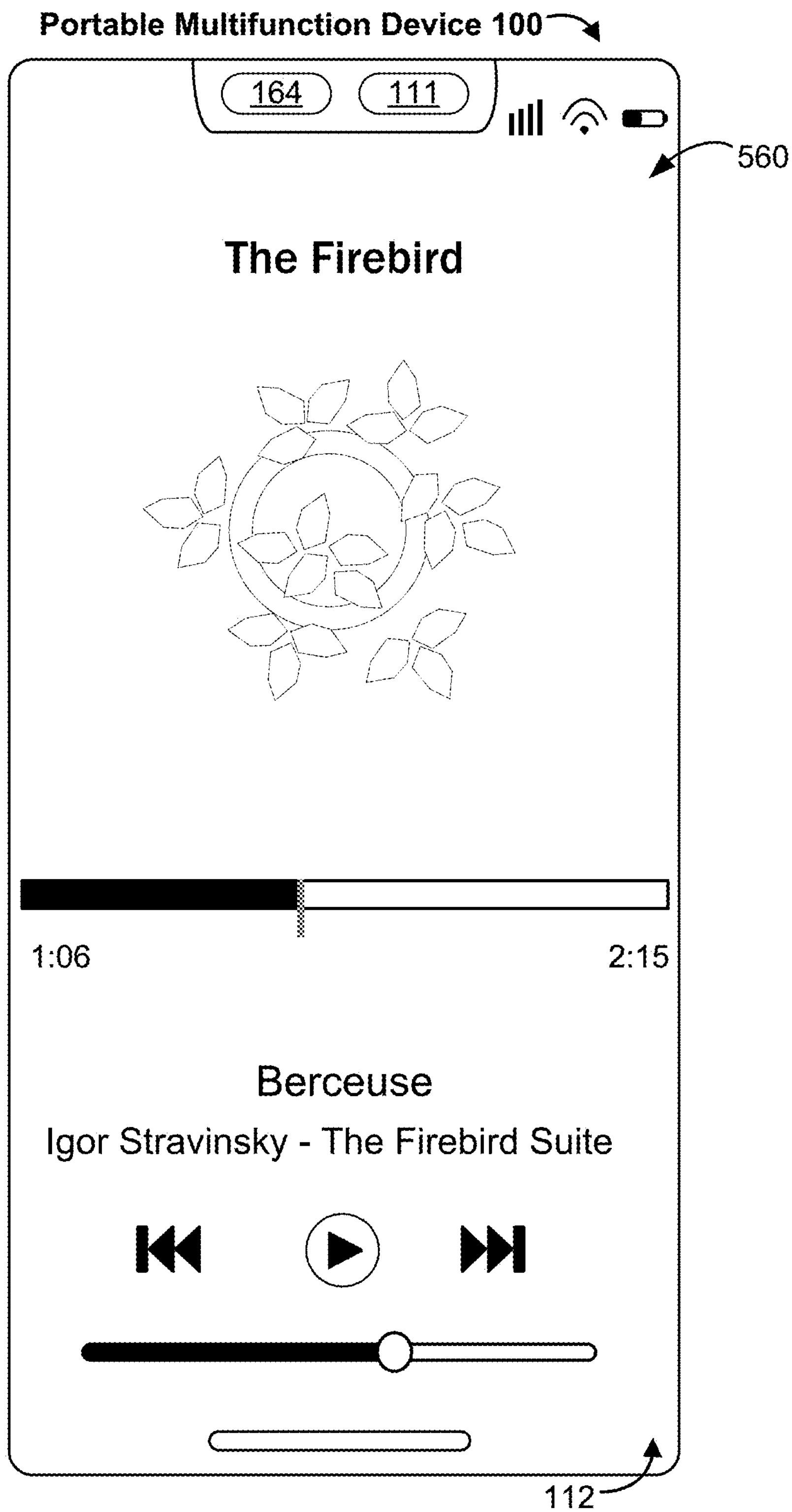

Portable Multifunction Device 100
6:02 PM
164
111
558
522
556
Sunday
14
280
73°
112

Figure 5AI



Portable Multifunction Device 100
164
111
560
The Firebird
1:06
2:15
Berceuse
Igor Stravinsky - The Firebird Suite
112

Figure 5AJ

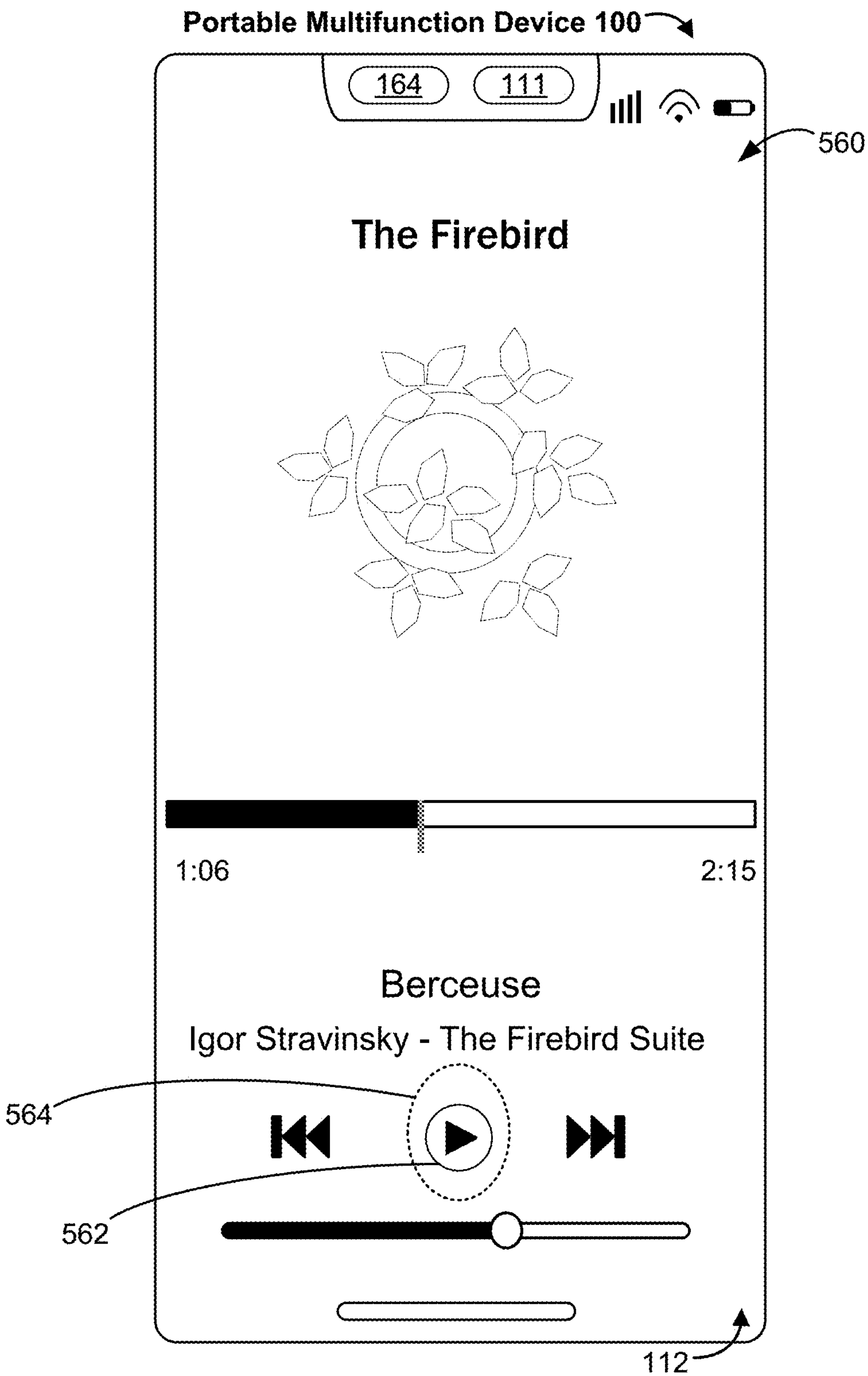

Portable Multifunction Device 100
164
111
560
The Firebird
1:06
2:15
Berceuse
Igor Stravinsky - The Firebird Suite
564
562
112

Figure 5AK

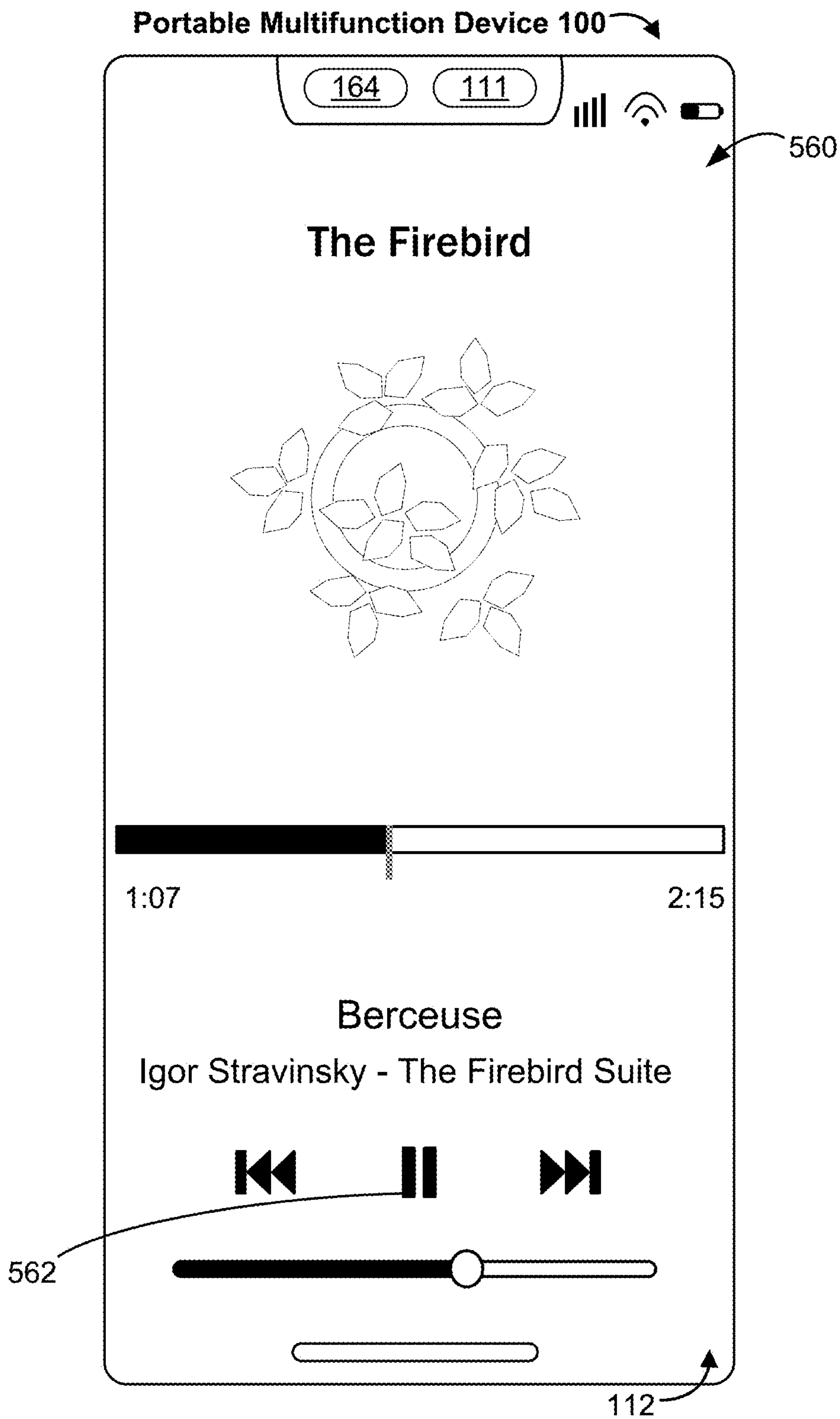

Portable Multifunction Device 100
164
111
560
The Firebird
1:07
2:15
Berceuse
Igor Stravinsky - The Firebird Suite
562
112

Figure 5AL

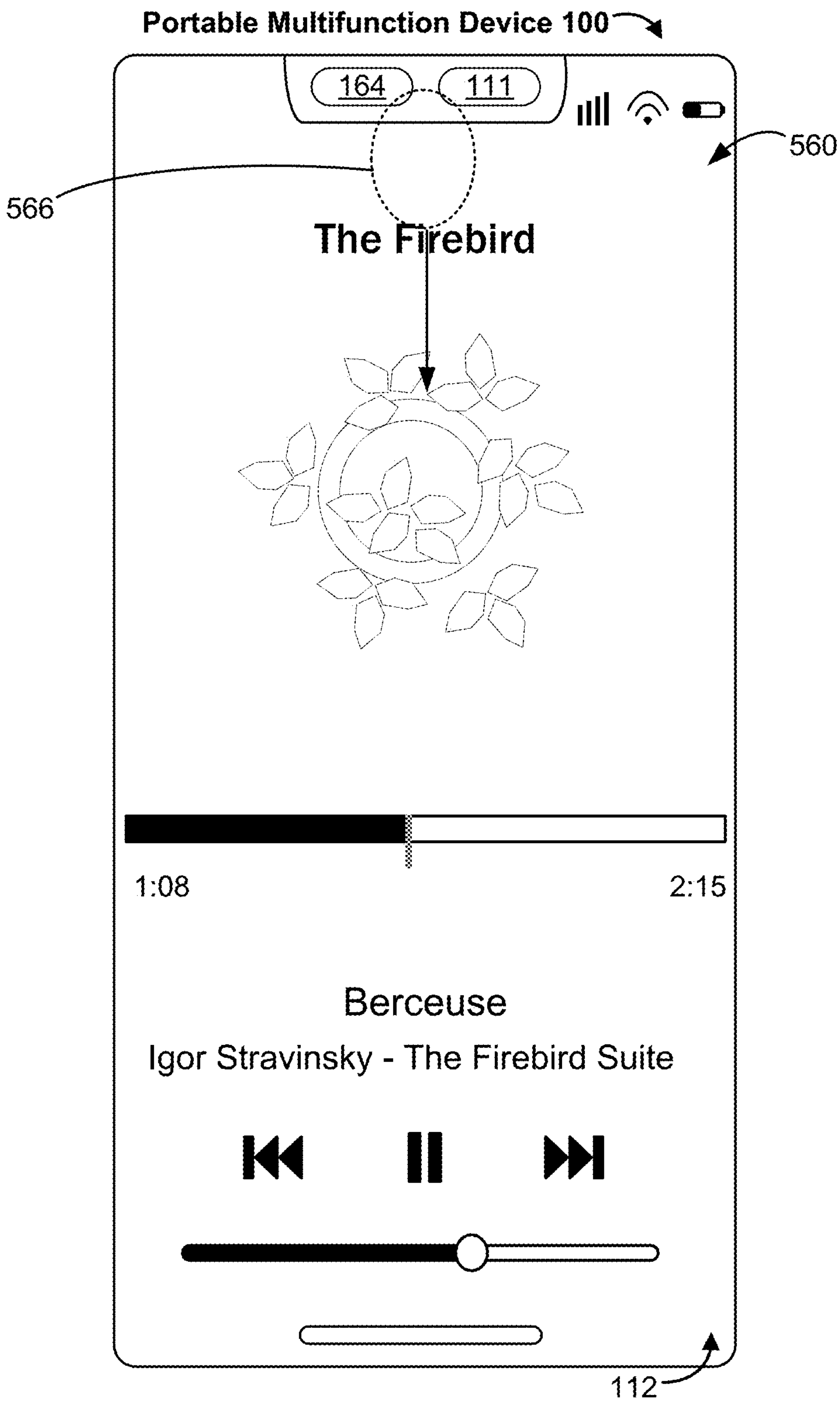

Portable Multifunction Device 100
164
111
560
566
The Firebird
1:08
2:15
Berceuse
Igor Stravinsky - The Firebird Suite
112

Figure 5AM

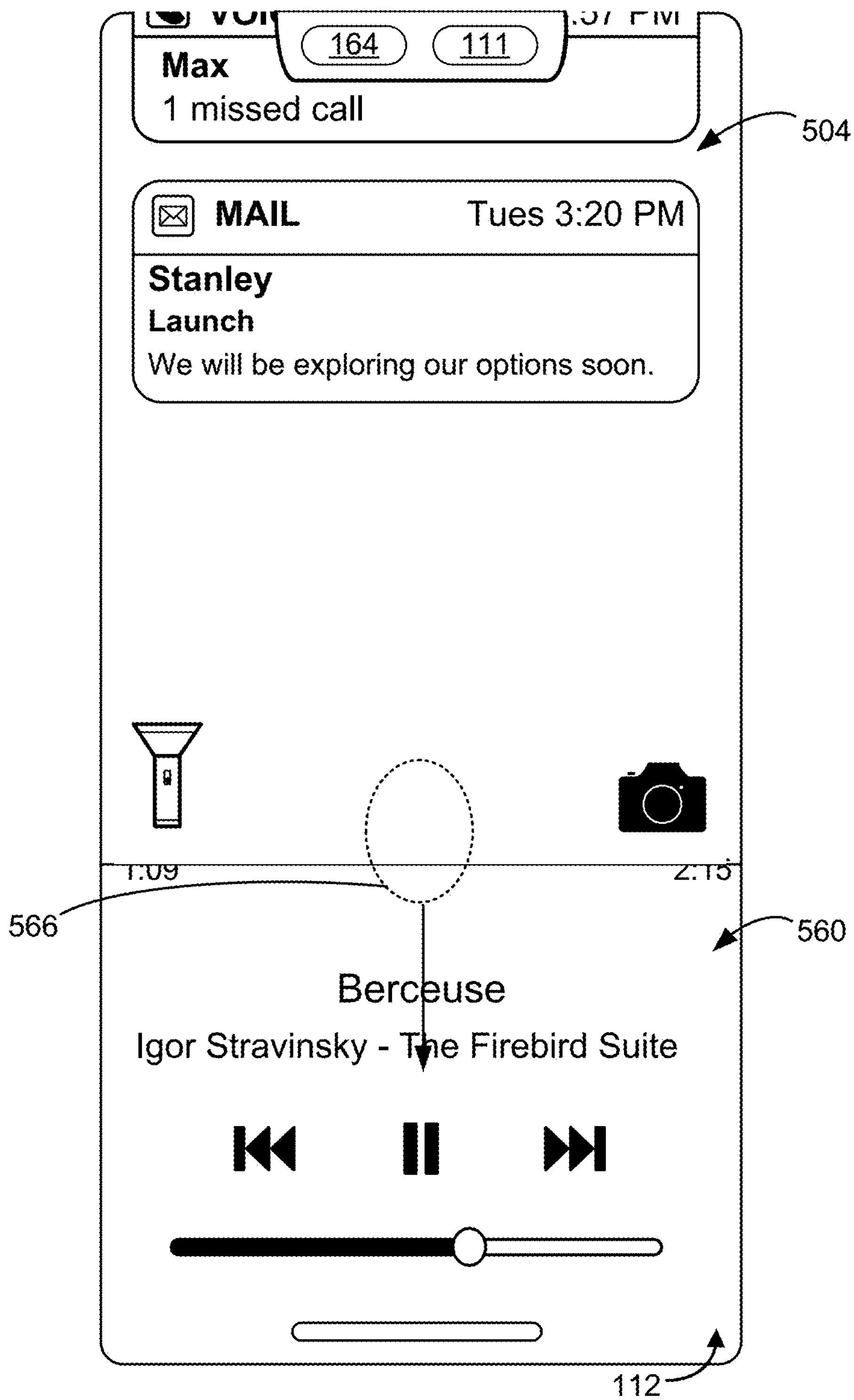

164
111
Max
1 missed call
504
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
566
560
Berceuse
Igor Stravinsky - The Firebird Suite
112

Figure 5AN

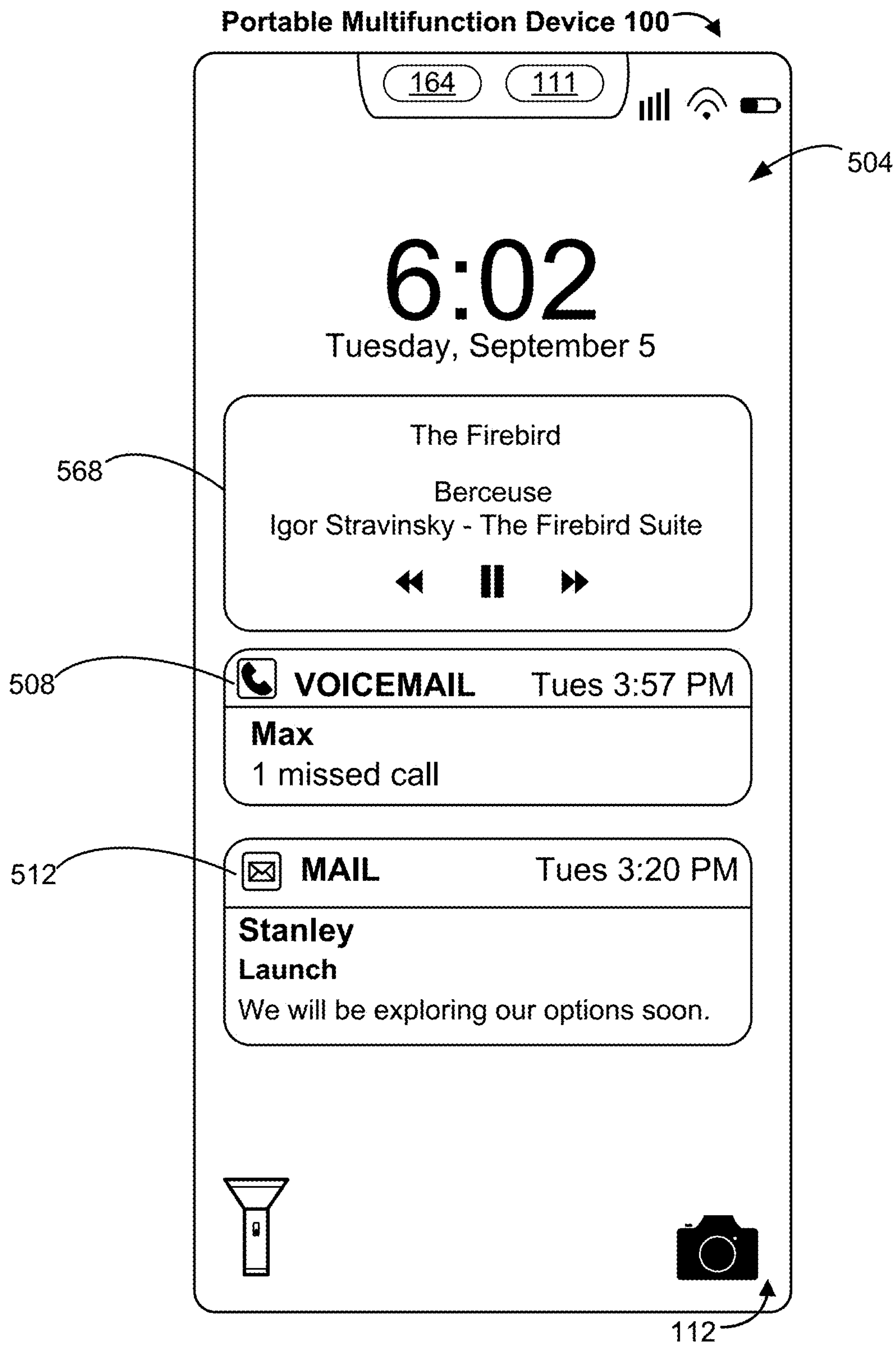

Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
568
The Firebird
Berceuse
Igor Stravinsky - The Firebird Suite
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
112

Figure 5AO

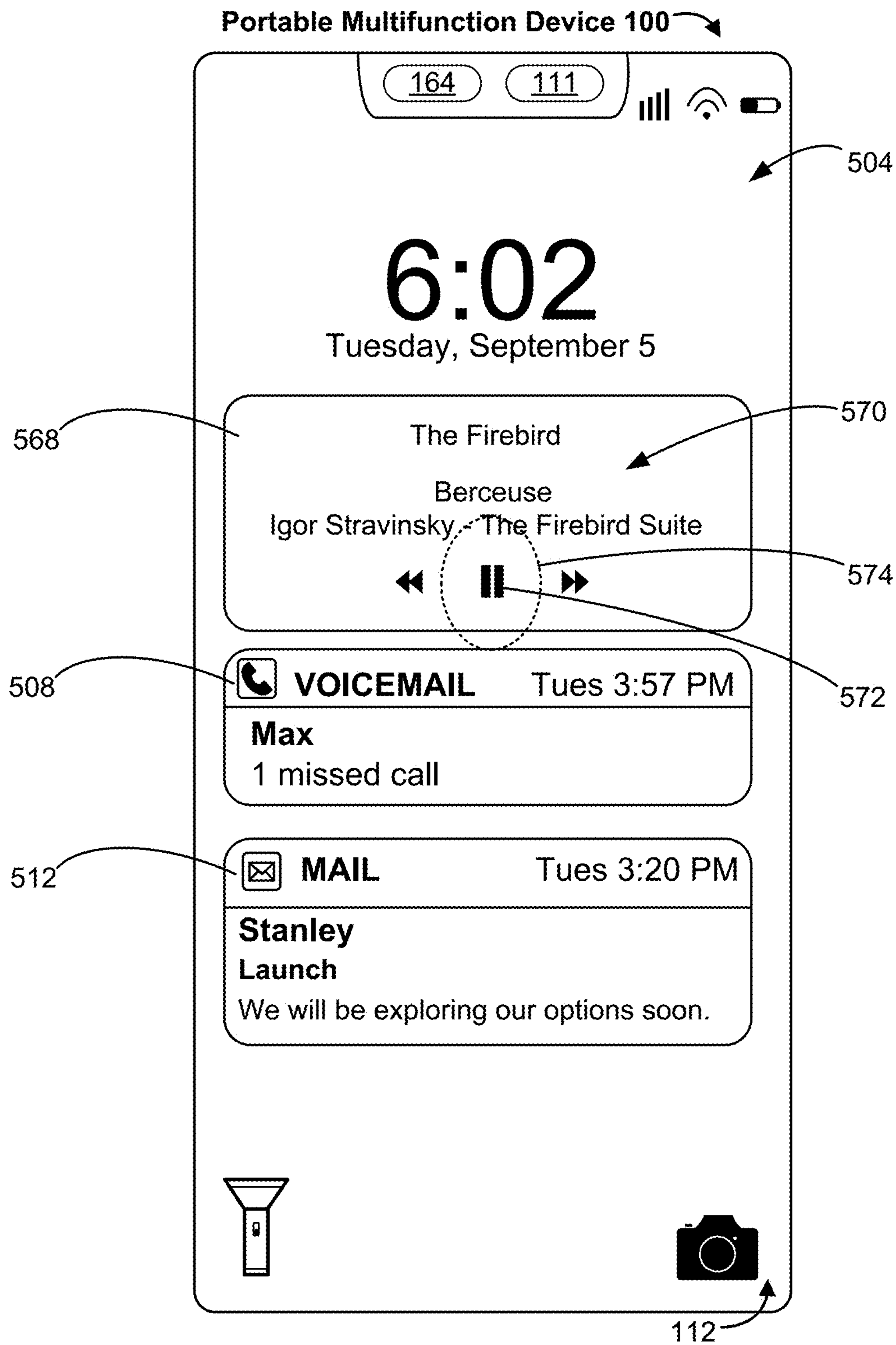
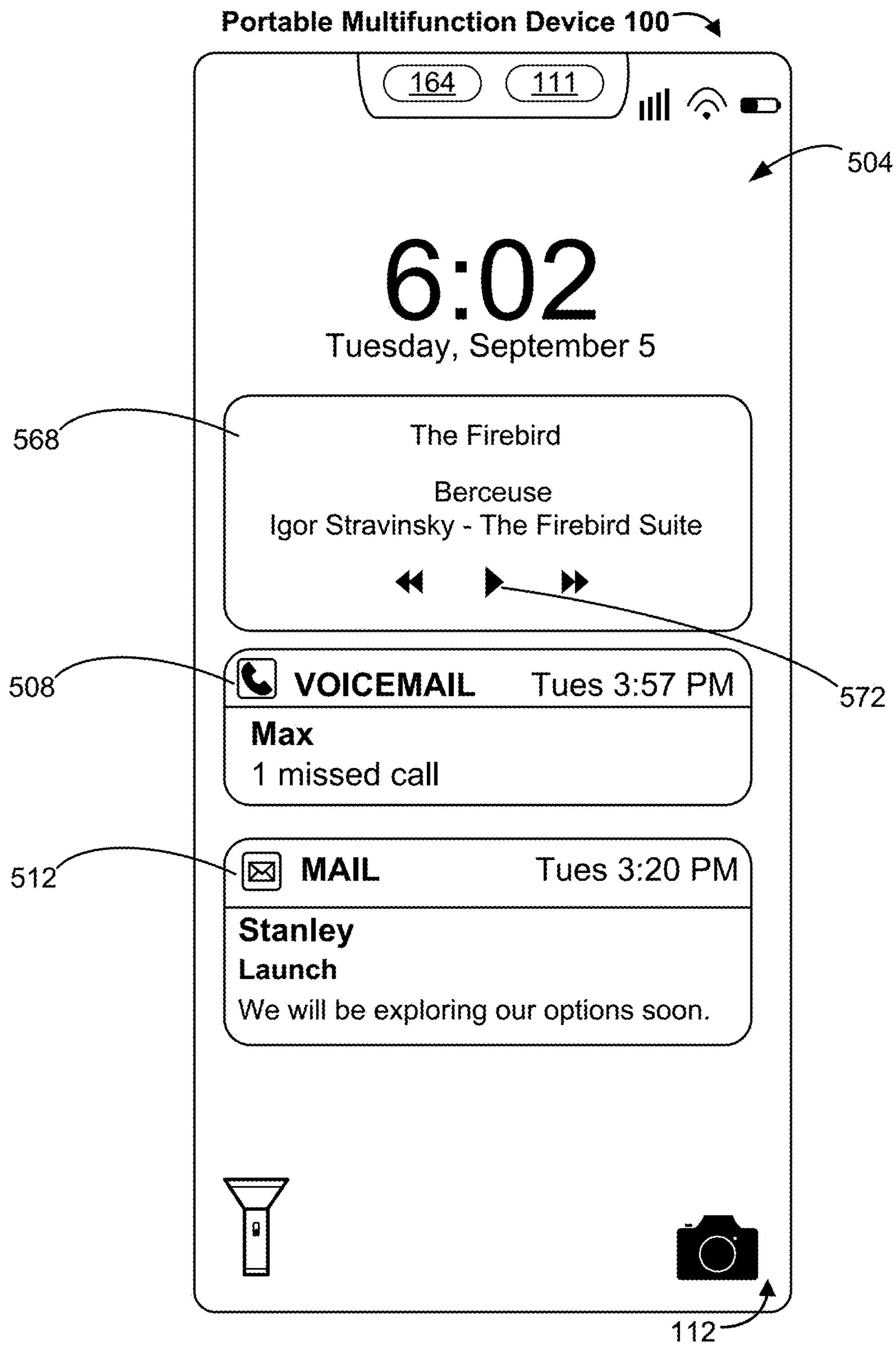
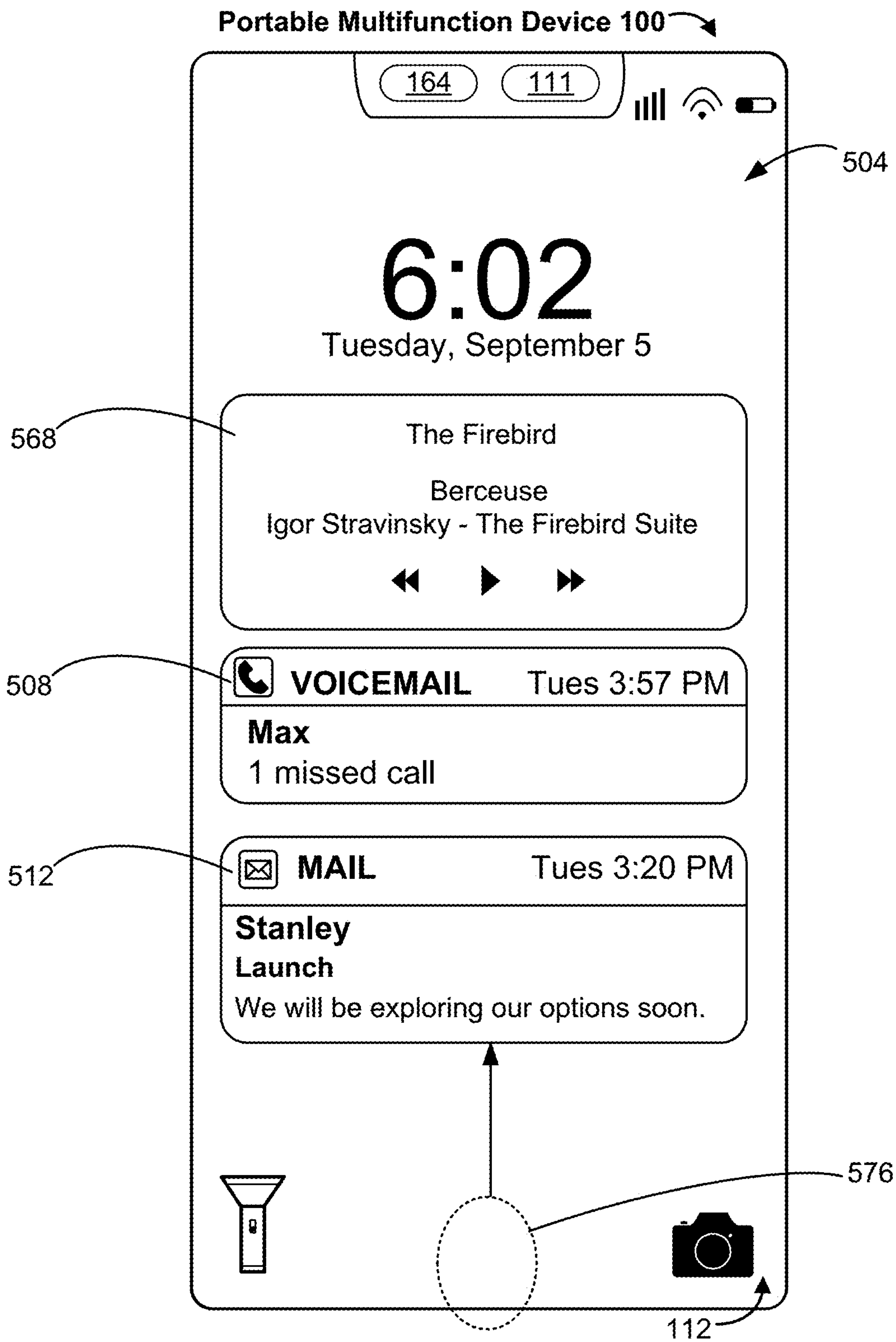

Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
568
570
The Firebird
Berceuse
Igor Stravinsky - The Firebird Suite
574
572
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
112

Figure 5AP



Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
568
The Firebird
Berceuse
Igor Stravinsky - The Firebird Suite
572
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
112

Figure 5AQ



Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
568
The Firebird
Berceuse
Igor Stravinsky - The Firebird Suite
508
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
512
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
576
112

Figure 5AR

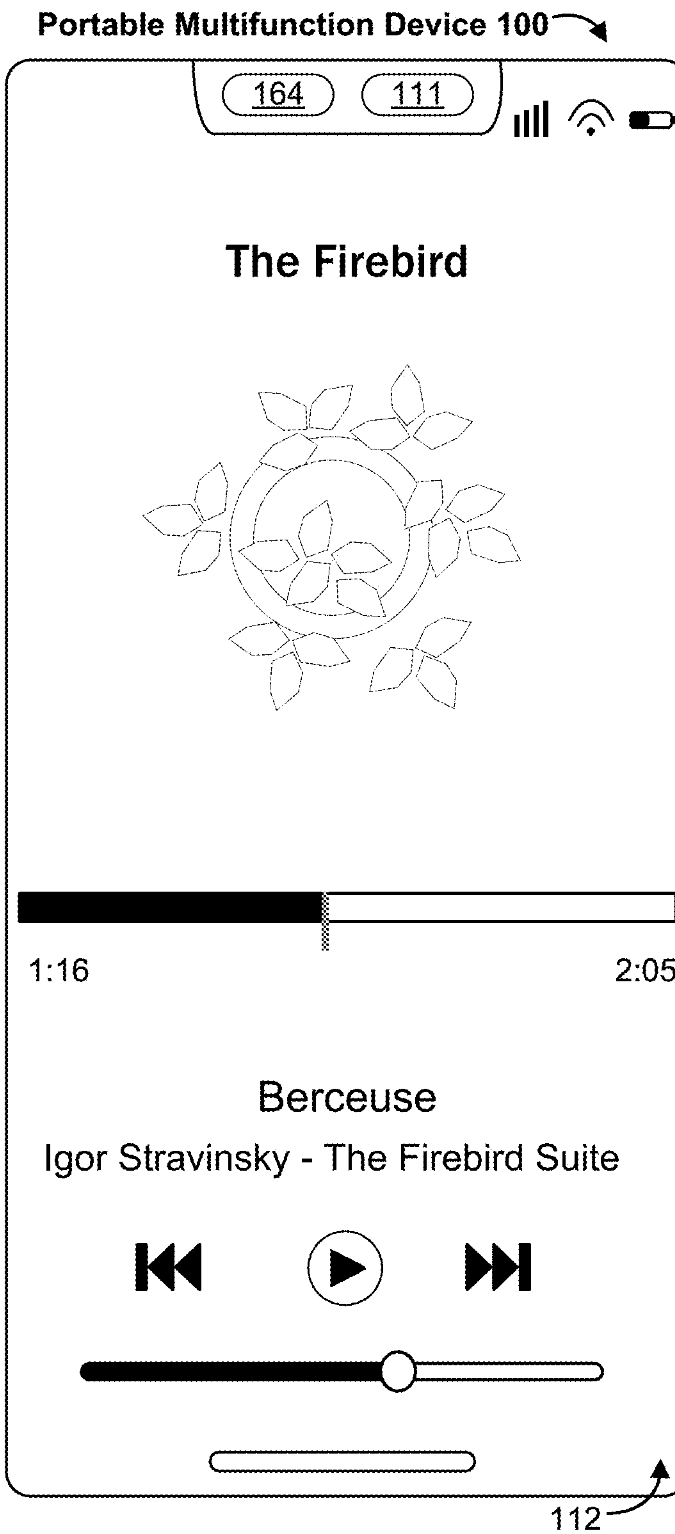

Portable Multifunction Device 100
164
111
The Firebird
1:16
2:05
Berceuse
Igor Stravinsky - The Firebird Suite
112

Figure 5AS

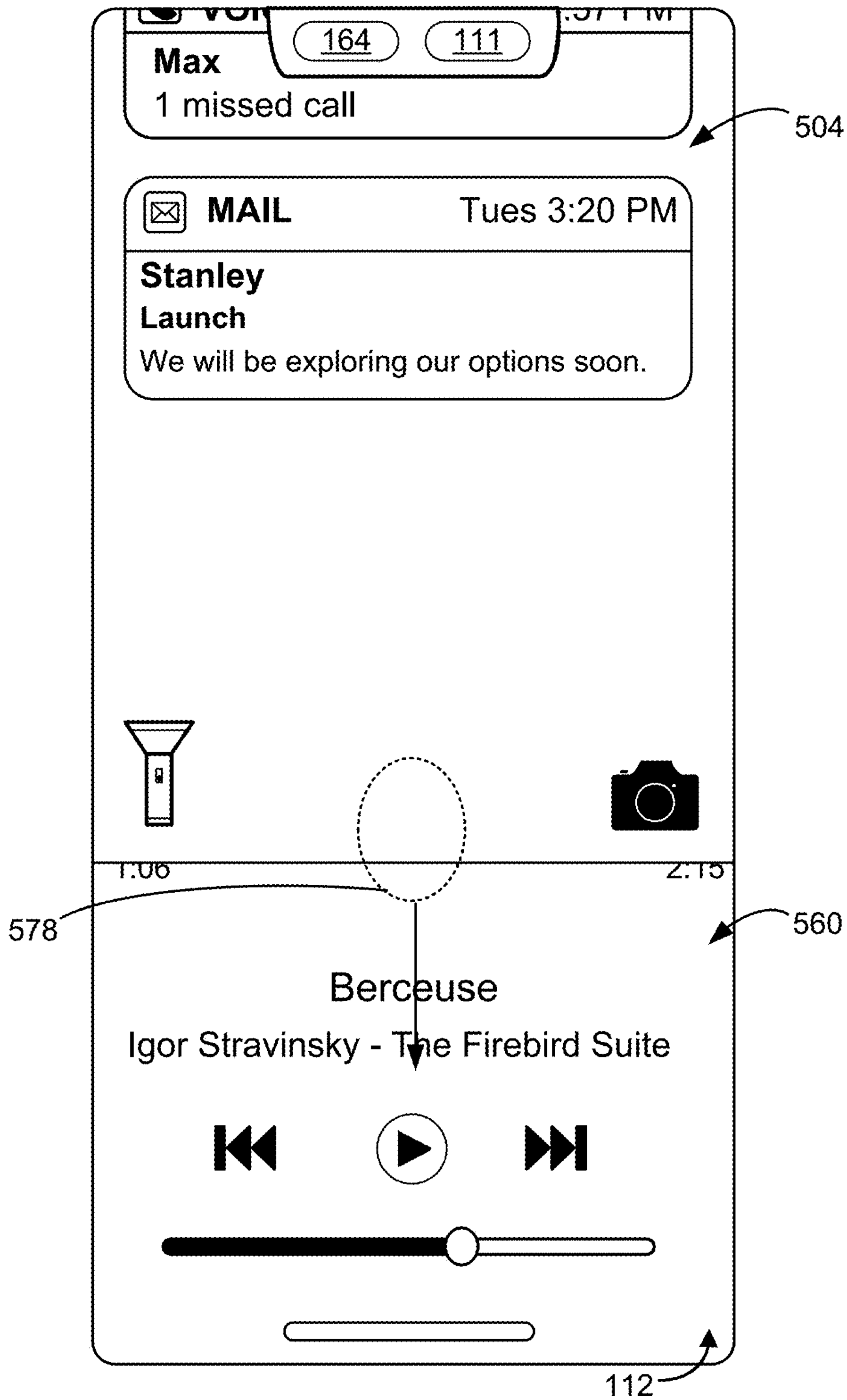

164
111
Max
1 missed call
504
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
1:06
2:15
578
560
Berceuse
Igor Stravinsky - The Firebird Suite
112

Figure 5AT

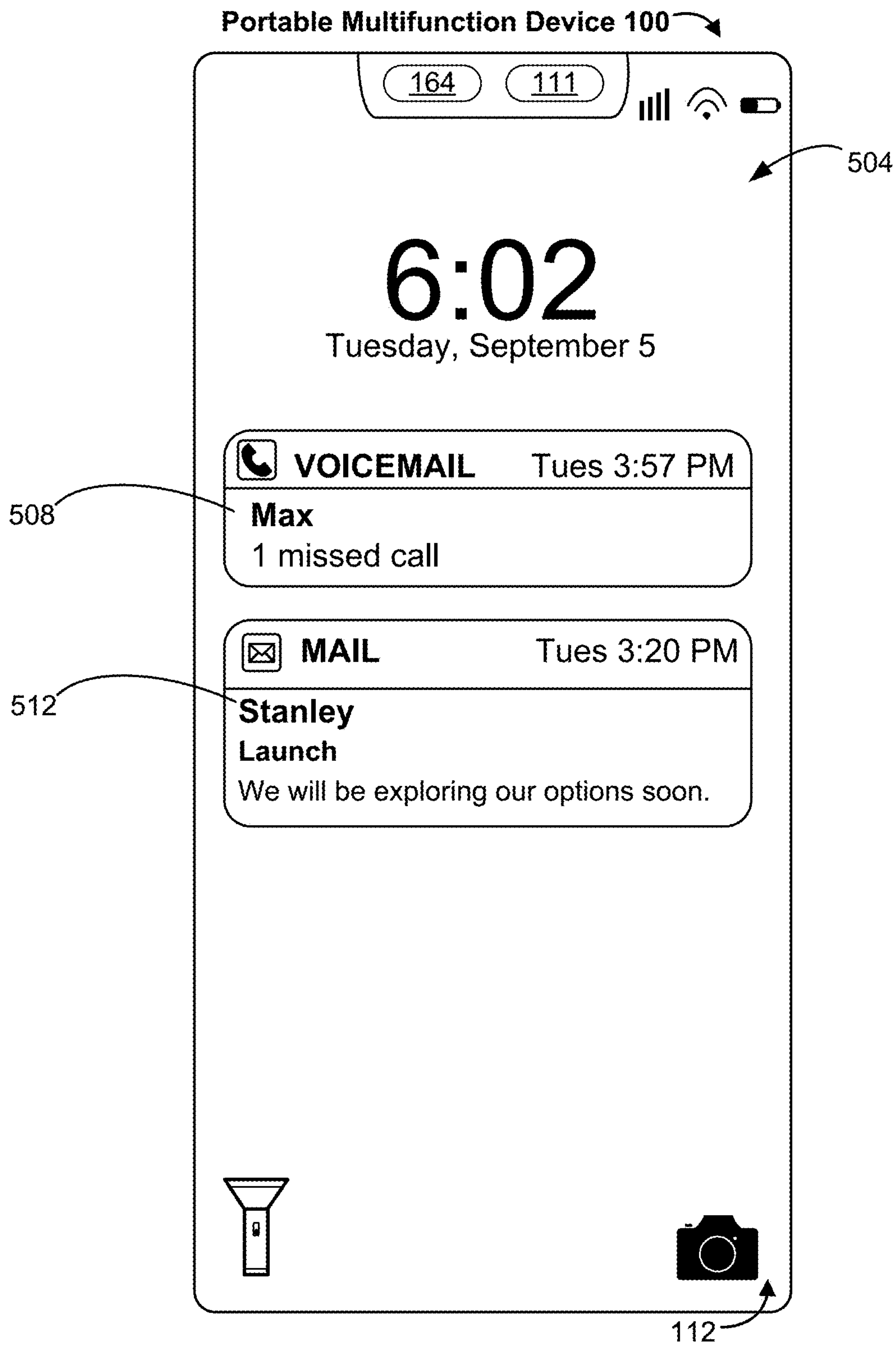

Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
VOICEMAIL Tues 3:57 PM
Max
1 missed call
508
MAIL Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
512
112

Figure 5AU

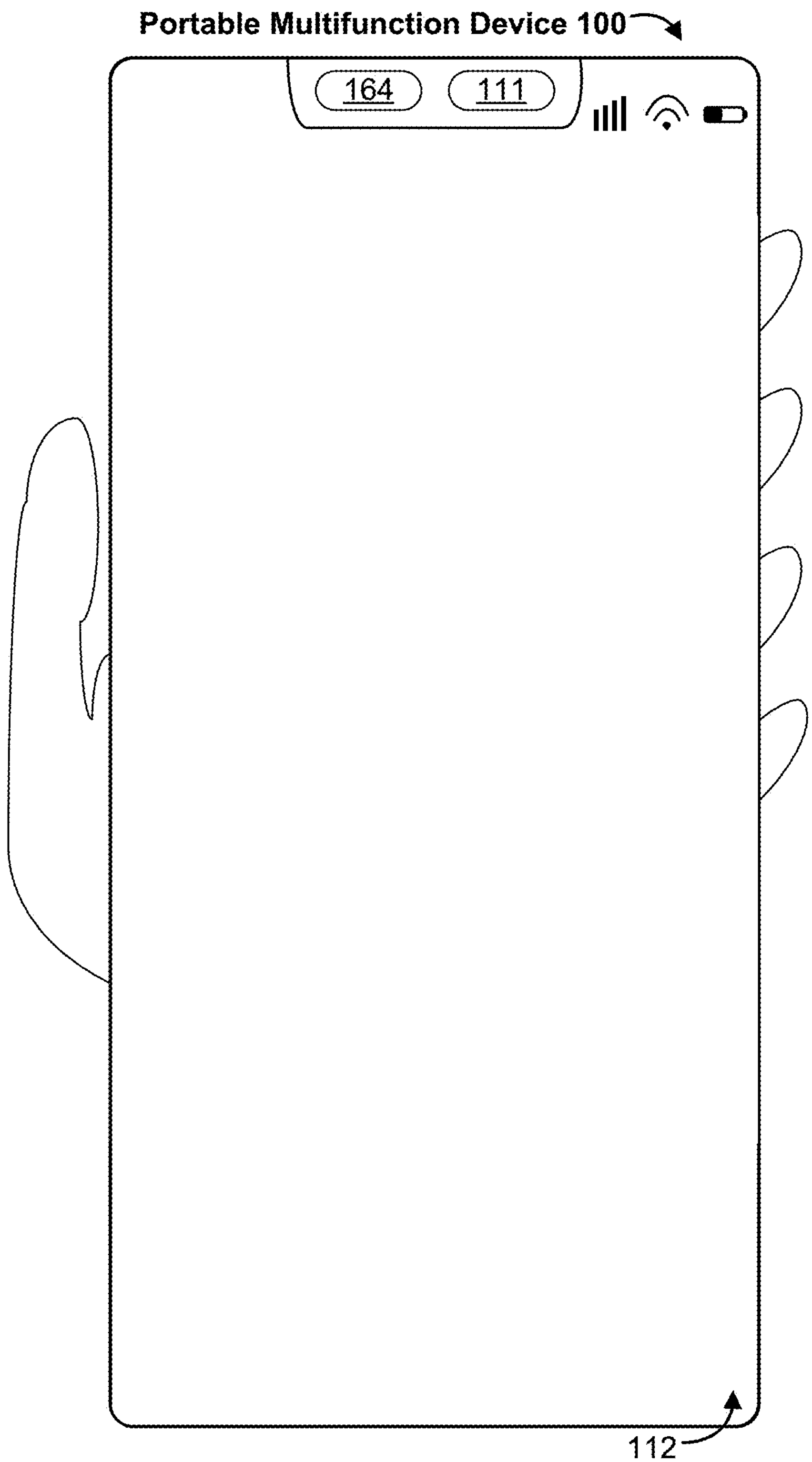


Figure 5AV

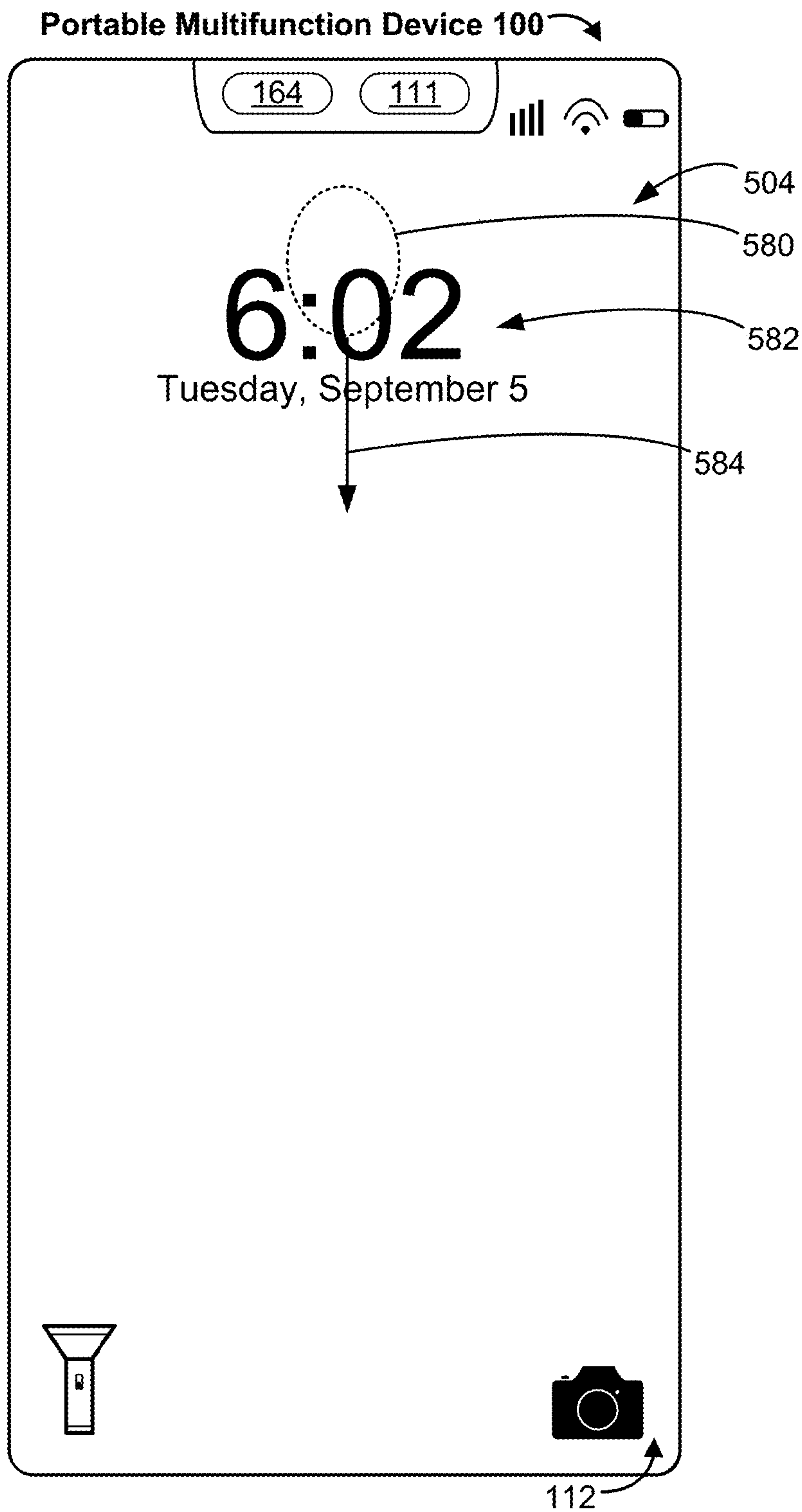

Portable Multifunction Device 100
164
111
504
580
6:02
582
Tuesday, September 5
584
112

Figure 5AW

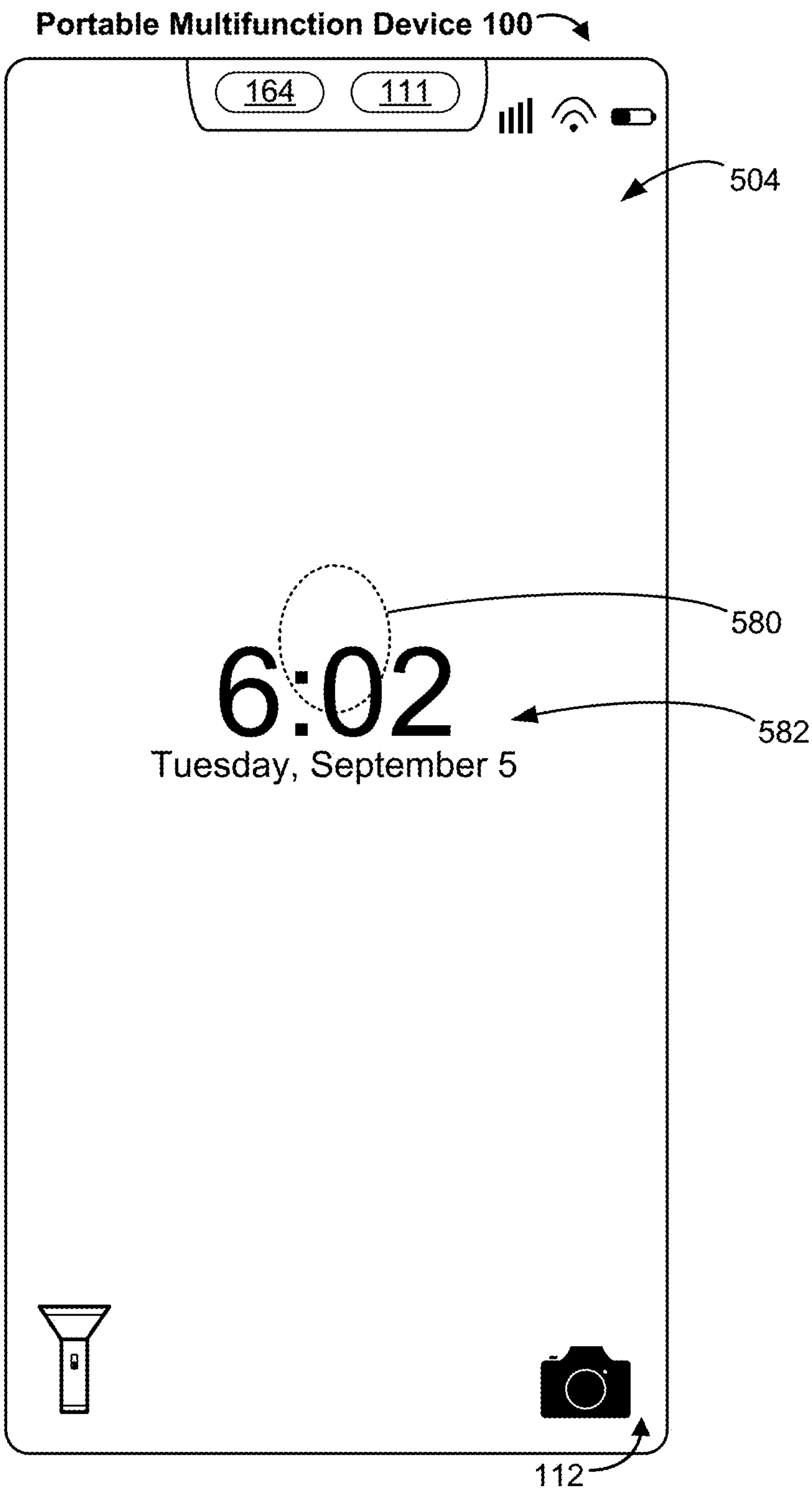

Portable Multifunction Device 100
164
111
504
580
6:02
582
Tuesday, September 5
112

Figure 5AX

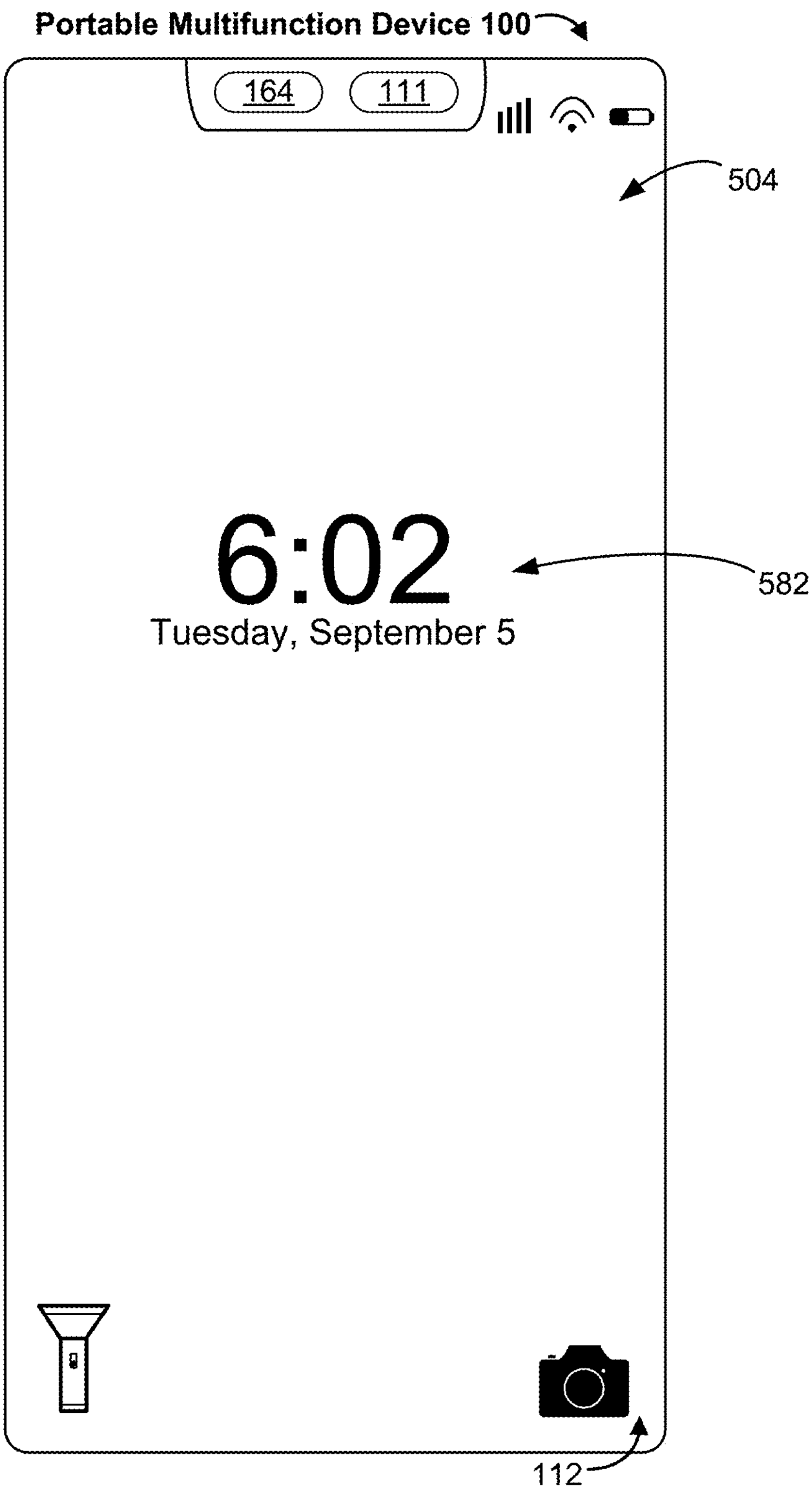
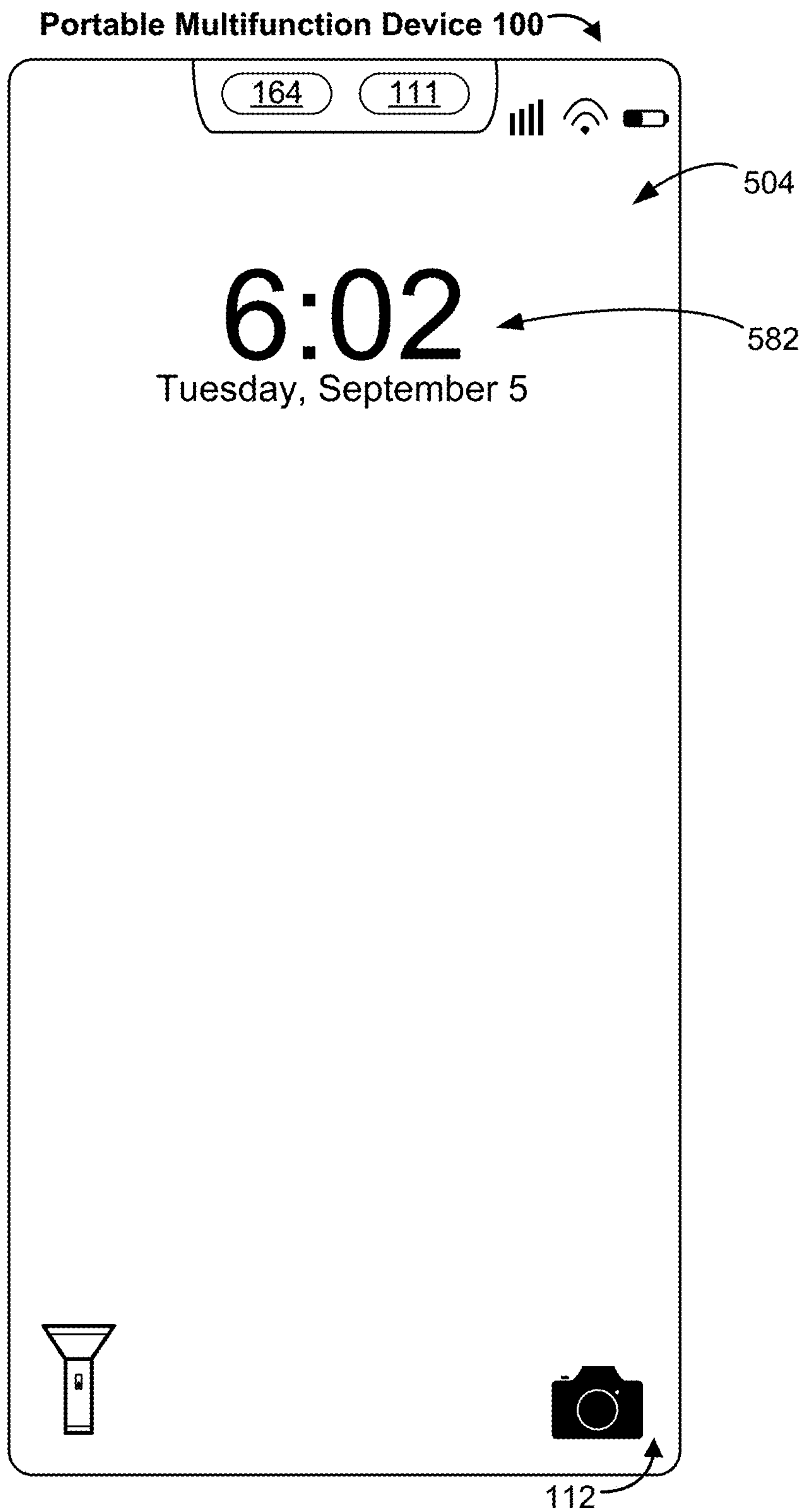
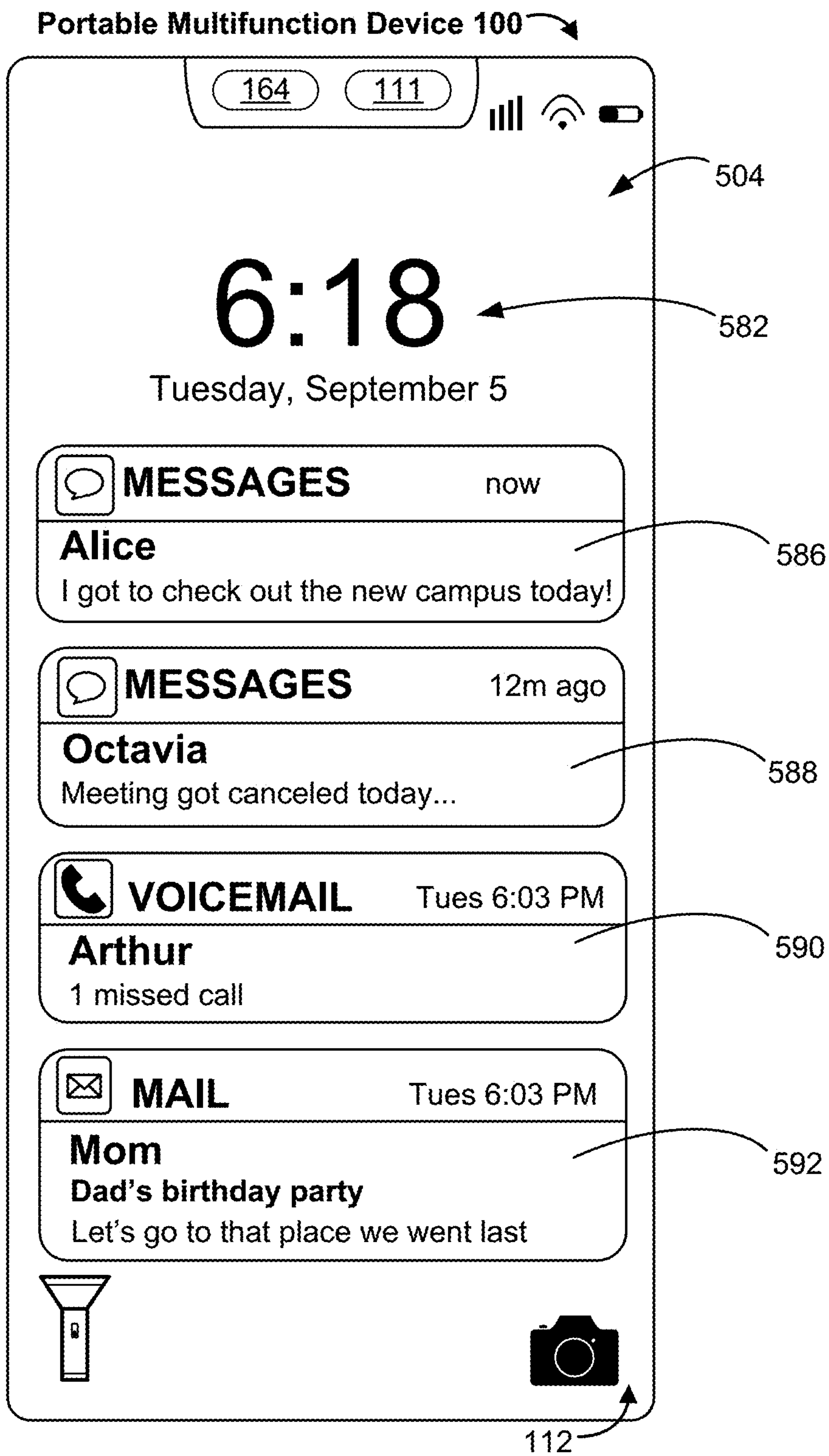

Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
582
112

Figure 5AY



Portable Multifunction Device 100
164
111
504
6:02
Tuesday, September 5
582
112

Figure 5AZ



Portable Multifunction Device 100
164
111
504
6:18
582
Tuesday, September 5
MESSAGES
now
Alice
I got to check out the new campus today!
586
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
112

Figure 5BA

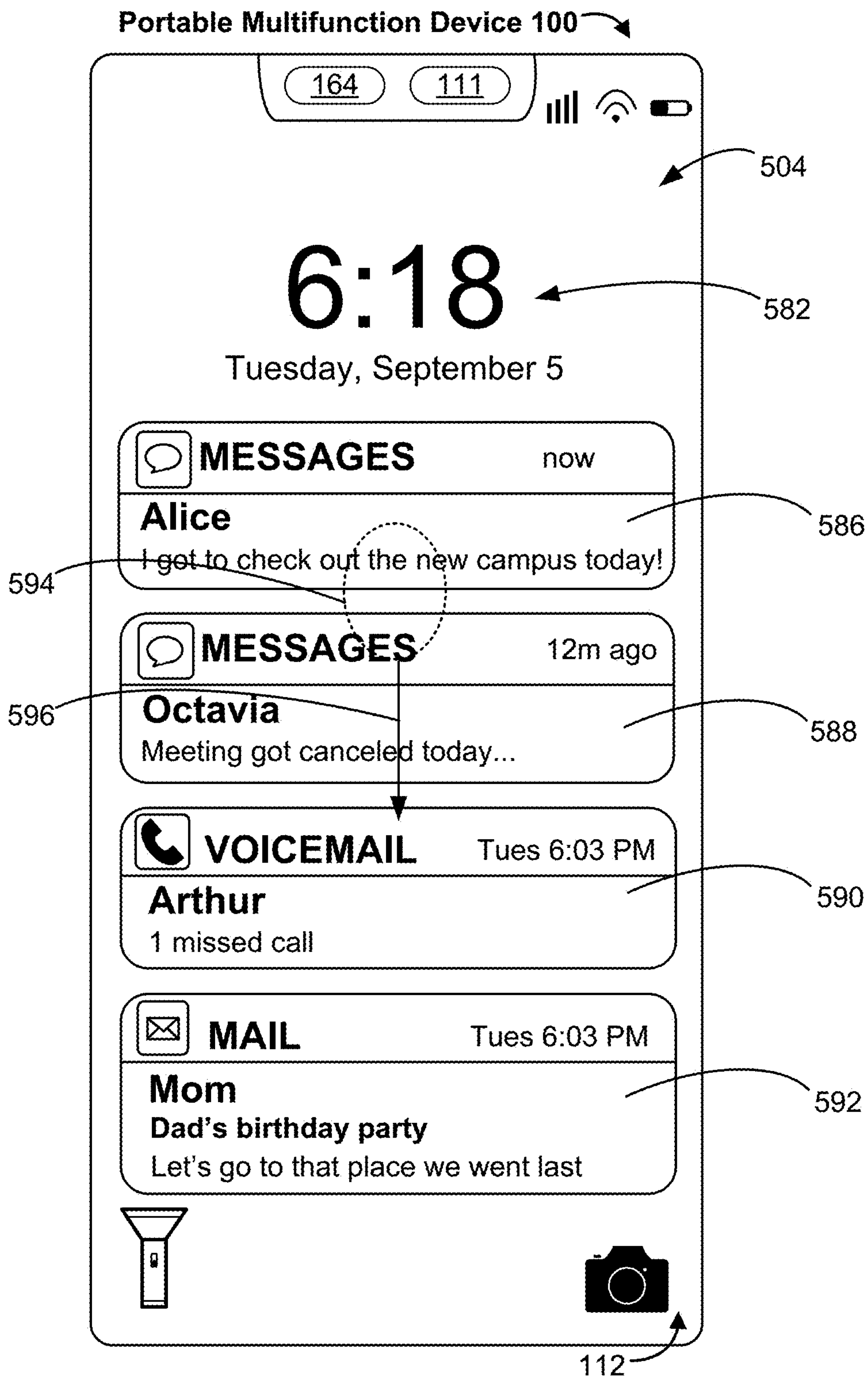
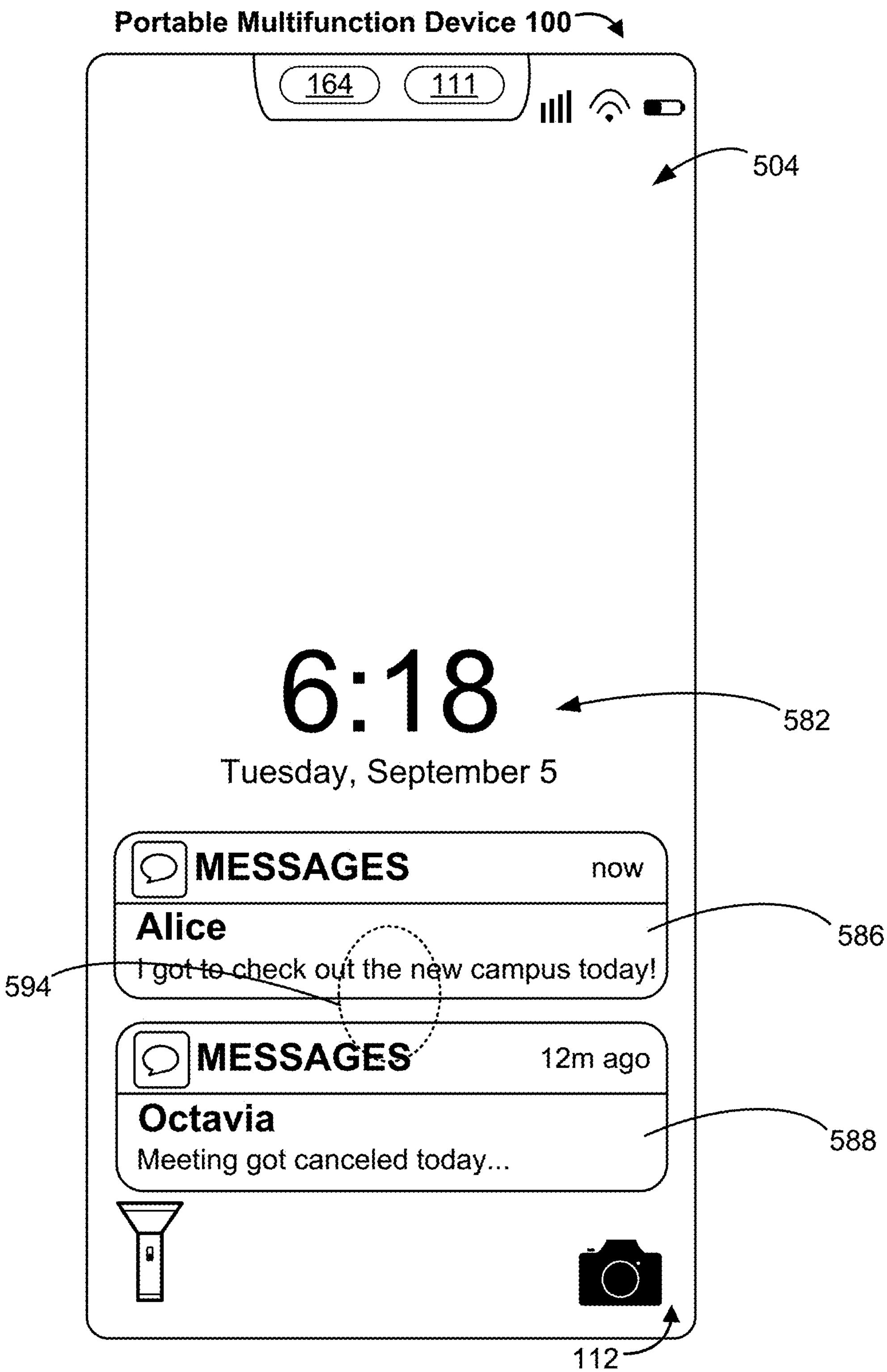

Portable Multifunction Device 100
164
111
504
6:18
582
Tuesday, September 5
MESSAGES
now
Alice
I got to check out the new campus today!
586
594
MESSAGES
12m ago
Octavia
Meeting got canceled today...
596
588
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
112

Figure 5BB



Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
582
MESSAGES
now
Alice
I got to check out the new campus today!
586
594
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
112

Figure 5BC

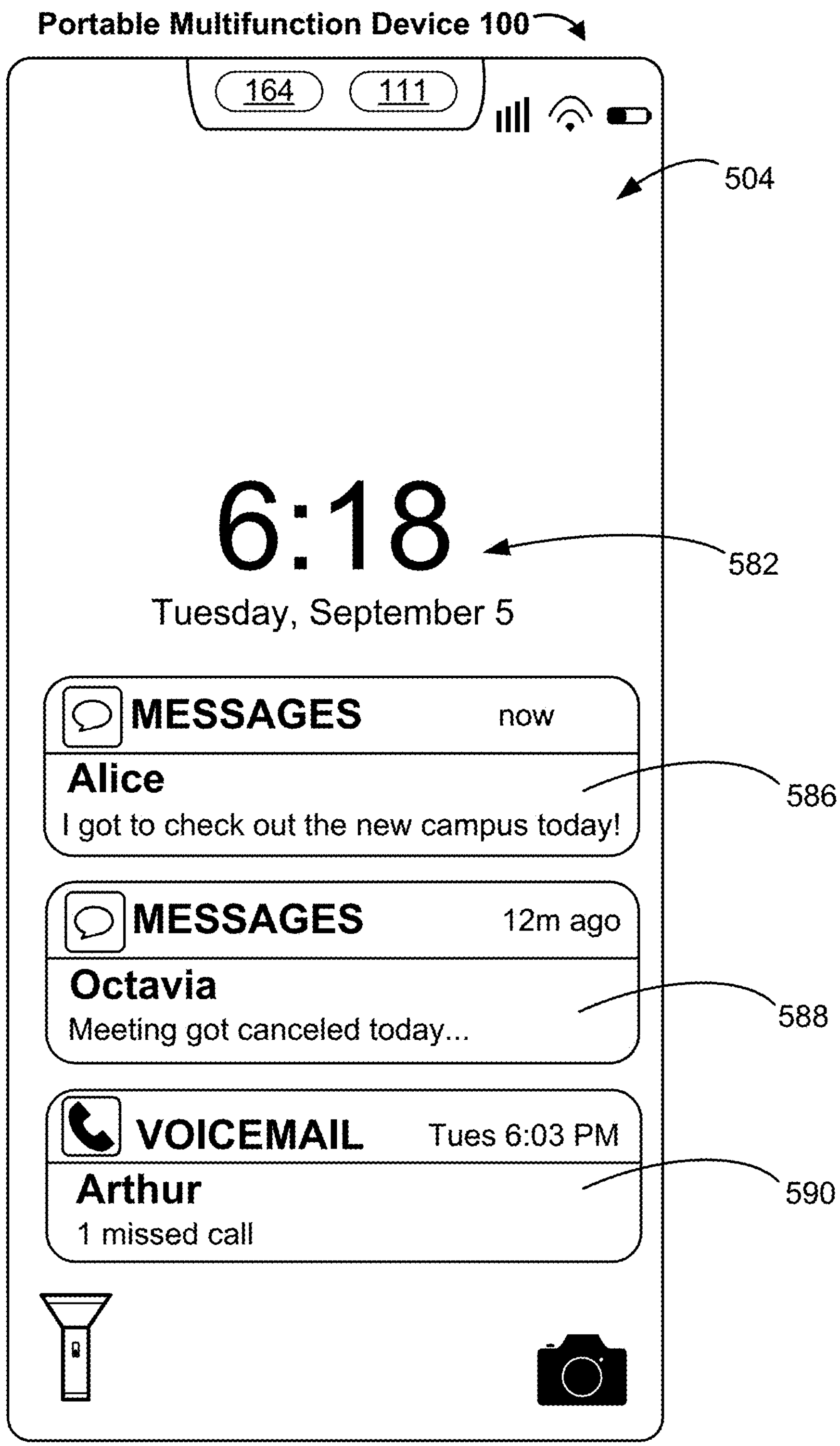
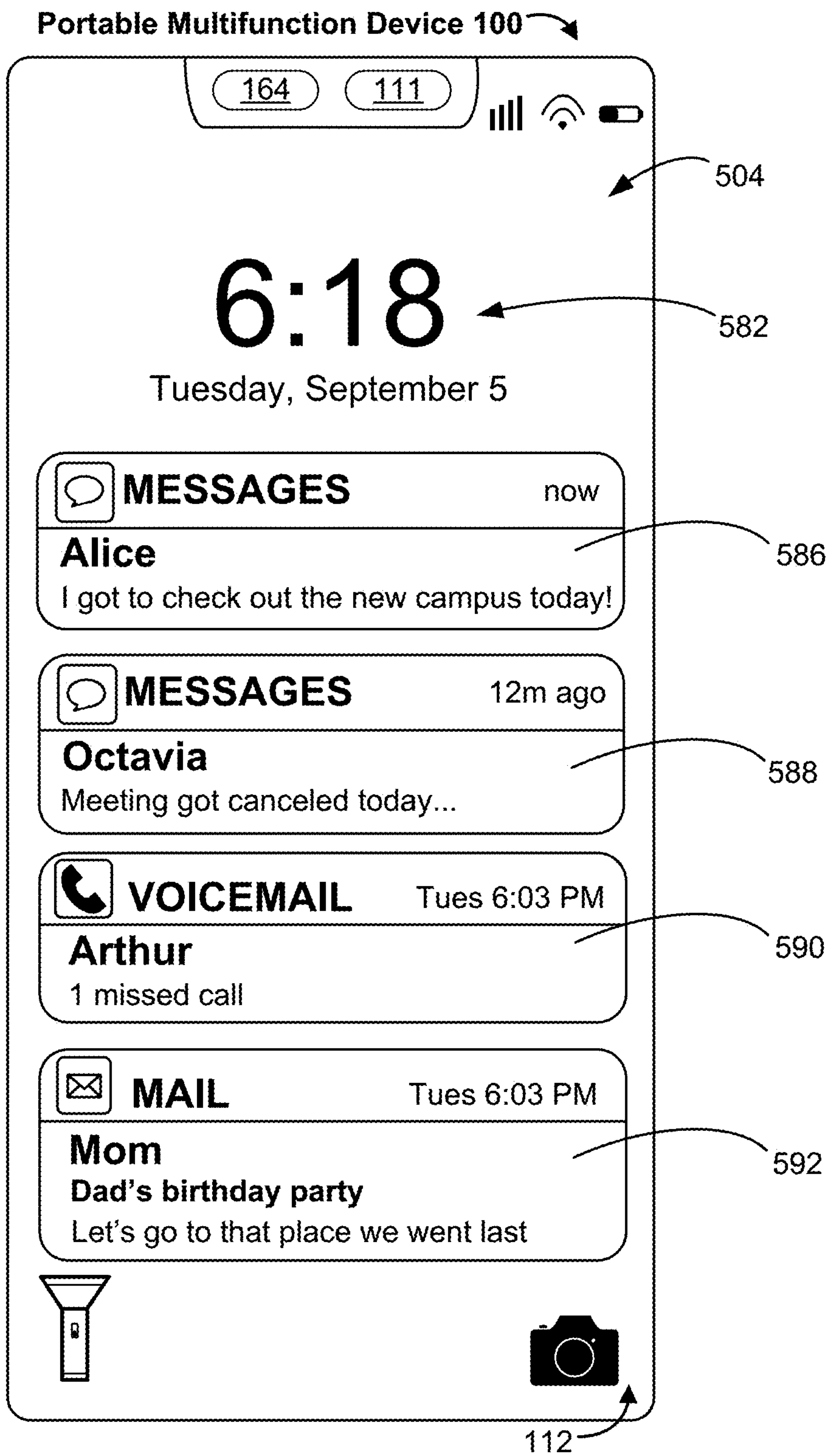

Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
582
MESSAGES
now
Alice
I got to check out the new campus today!
586
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590

Figure 5BD



Portable Multifunction Device 100
164
111
504
6:18
582
Tuesday, September 5
MESSAGES
now
Alice
I got to check out the new campus today!
586
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
112

Figure 5BE

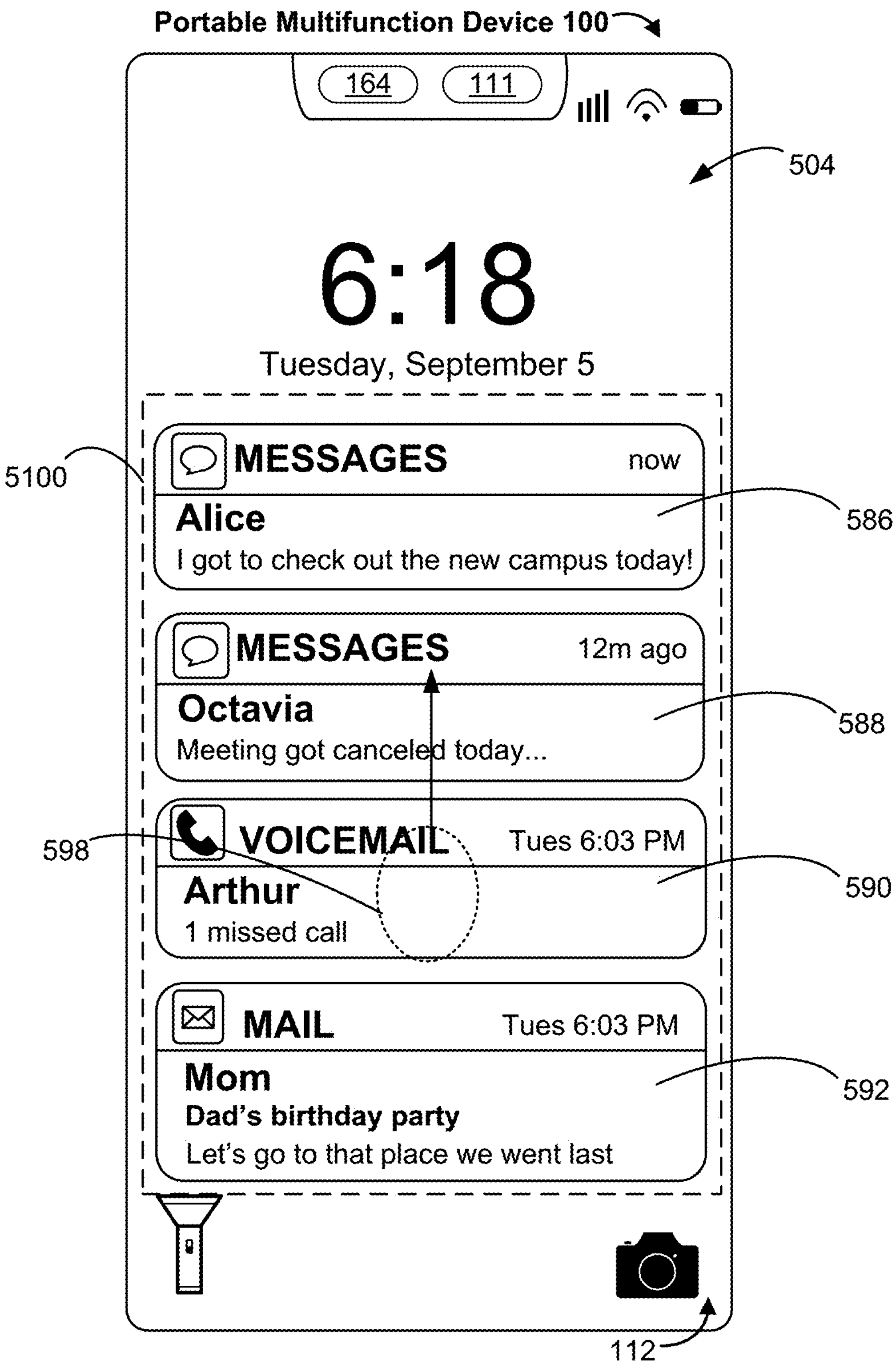
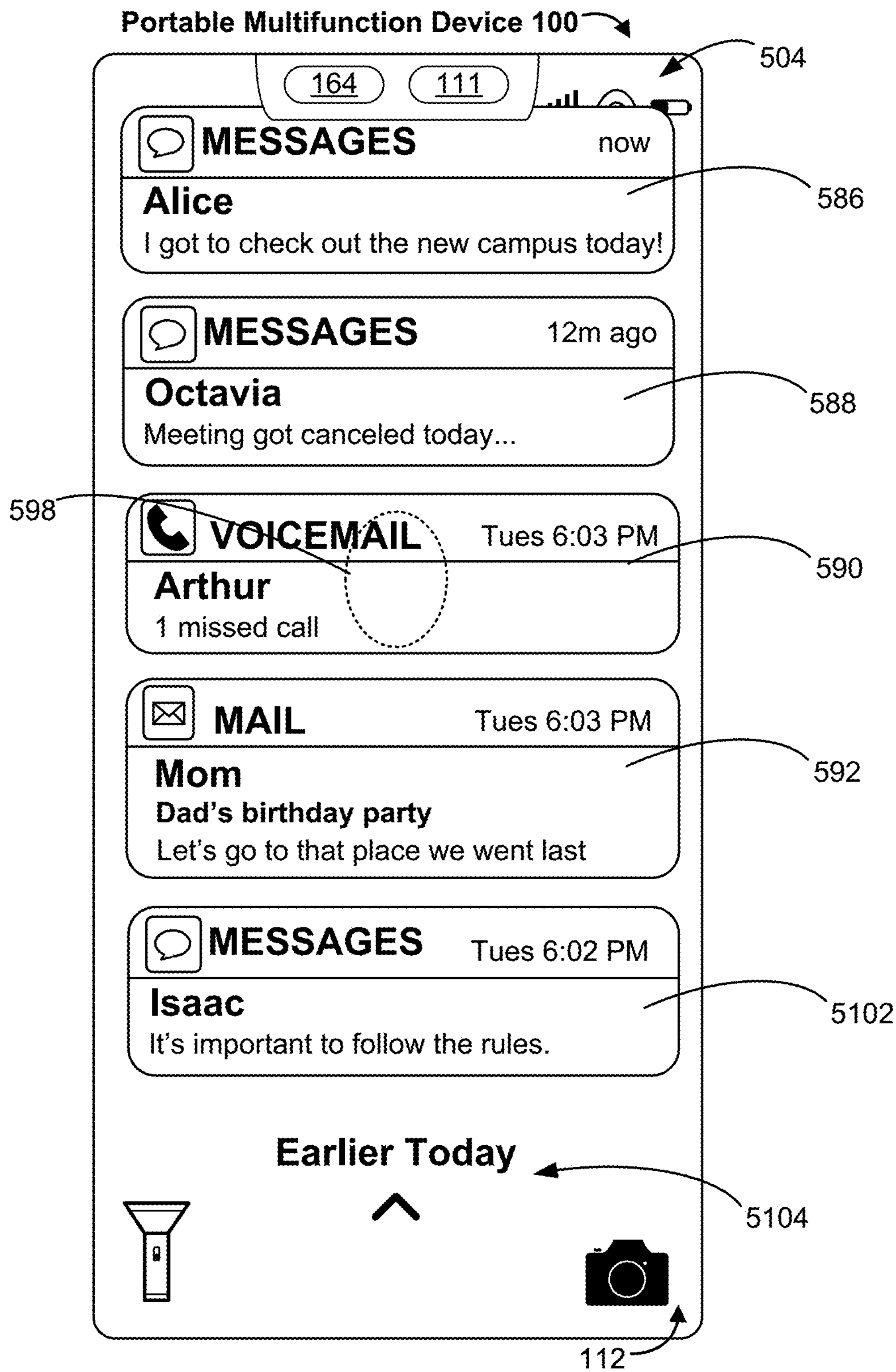

Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
5100
MESSAGES
now
Alice
I got to check out the new campus today!
586
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
598
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
112

Figure 5BF



Portable Multifunction Device 100
504
164
111
MESSAGES
now
Alice
I got to check out the new campus today!
586
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
598
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
5104
112

Figure 5BG

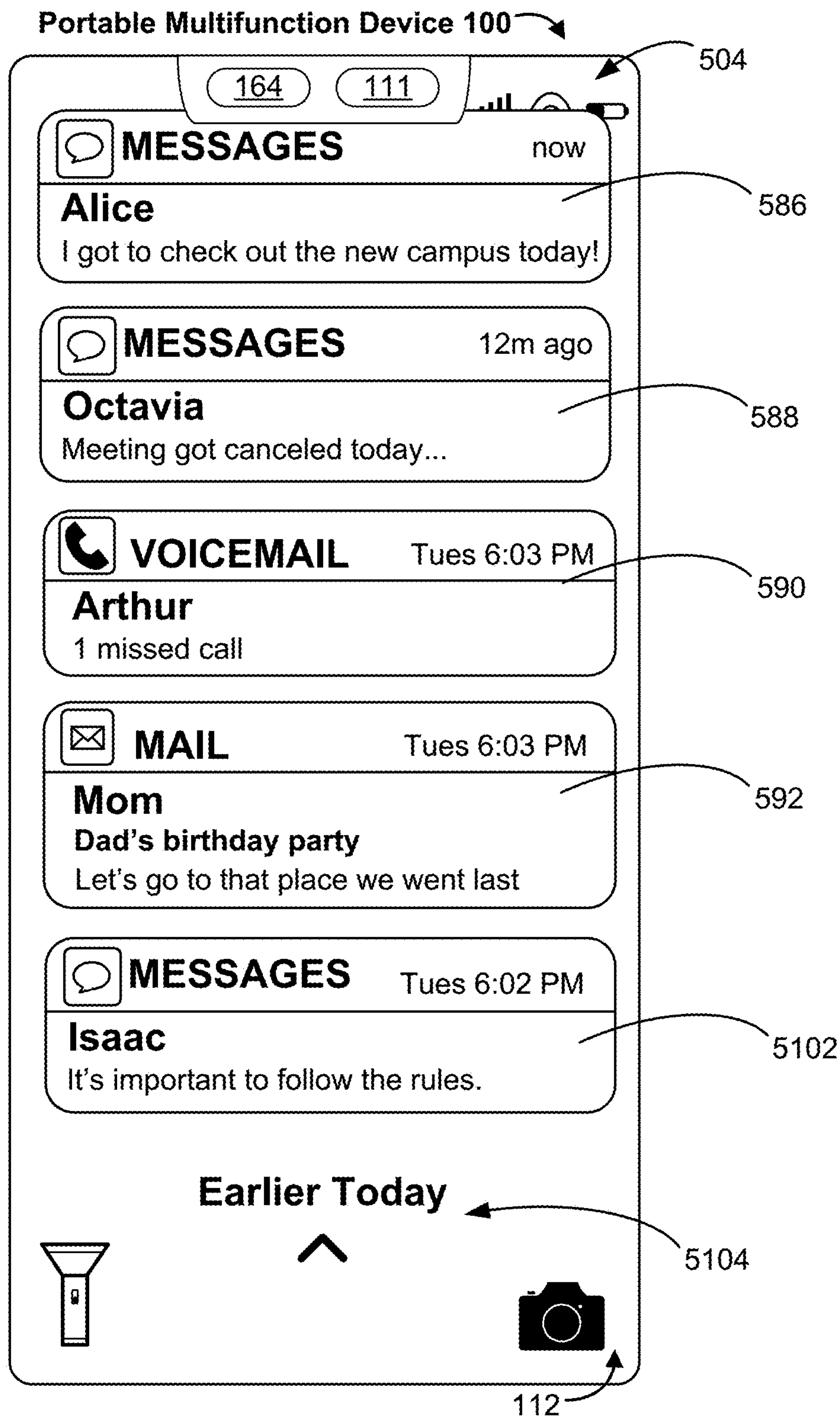
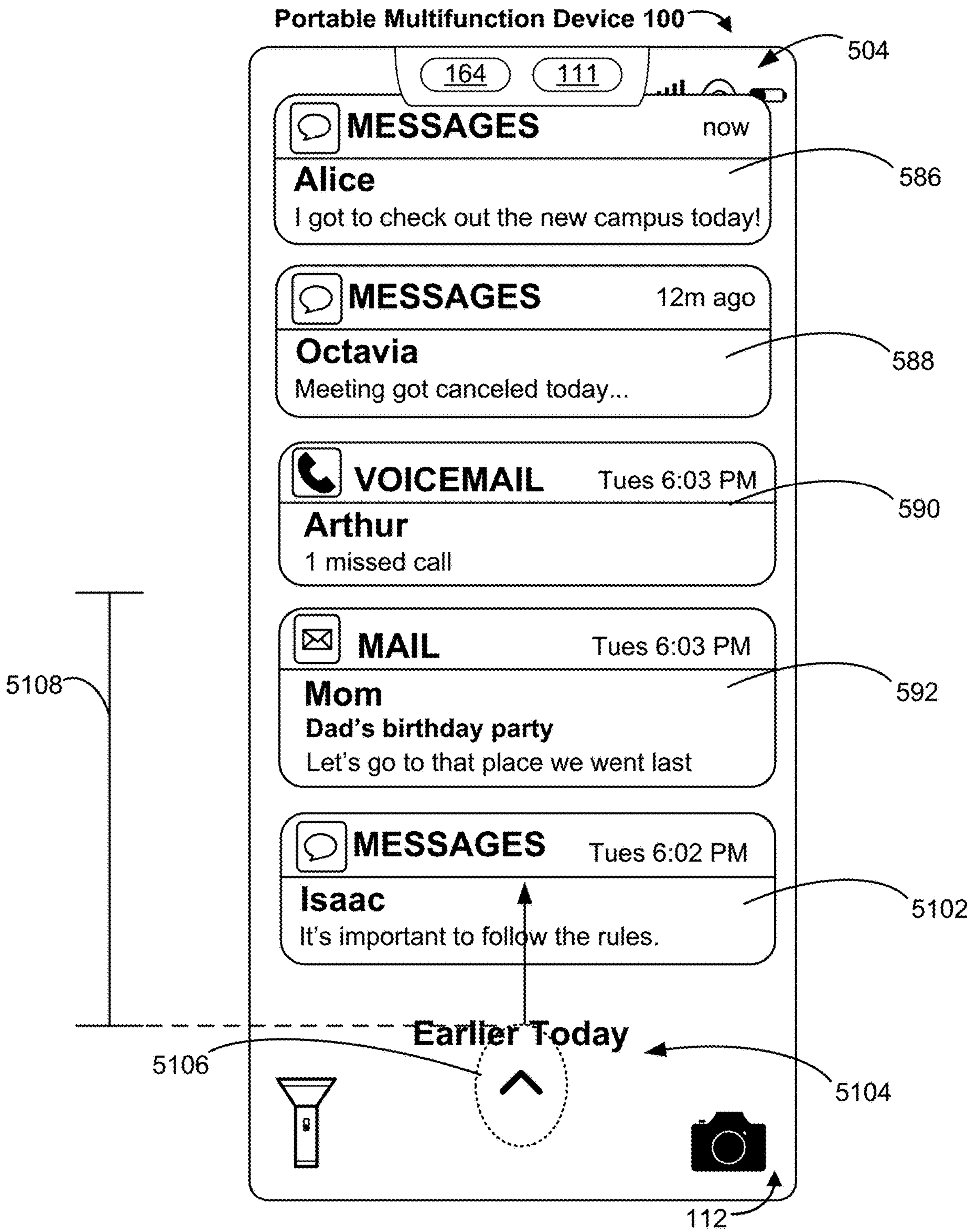

Portable Multifunction Device 100
504
164
111
MESSAGES
now
Alice
I got to check out the new campus today!
586
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
5104
112

Figure 5BH



Portable Multifunction Device 100
504
164
111
MESSAGES
now
Alice
I got to check out the new campus today!
586
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
5108
Earlier Today
5106
5104
112

Figure 5BI

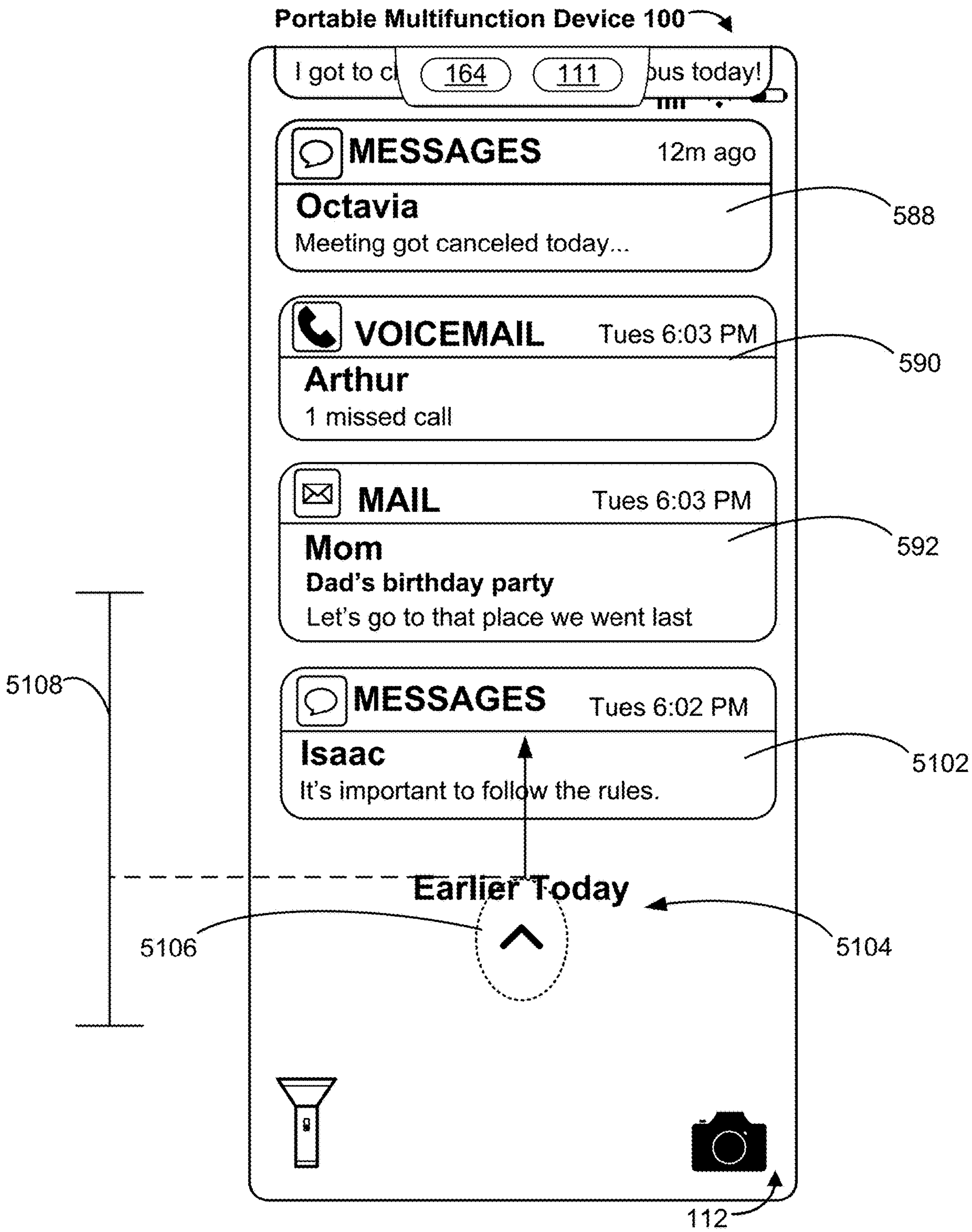
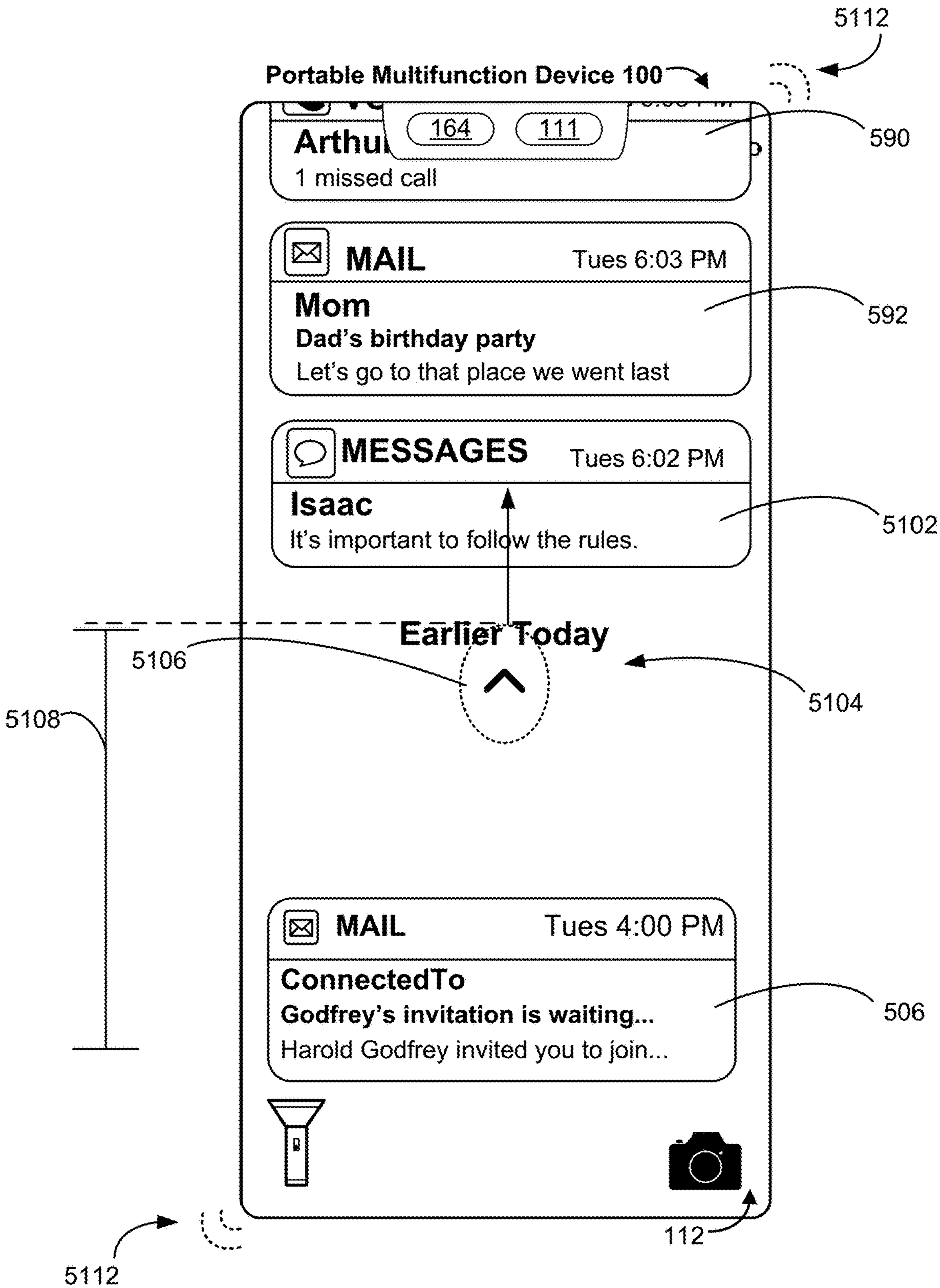

Portable Multifunction Device 100
I got to cl
164
111
ous today!
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
5108
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
5106
5104
112

Figure 5BJ



5112
Portable Multifunction Device 100
164
111
Arthu
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
5106
5104
5108
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
112
5112

Figure 5BK

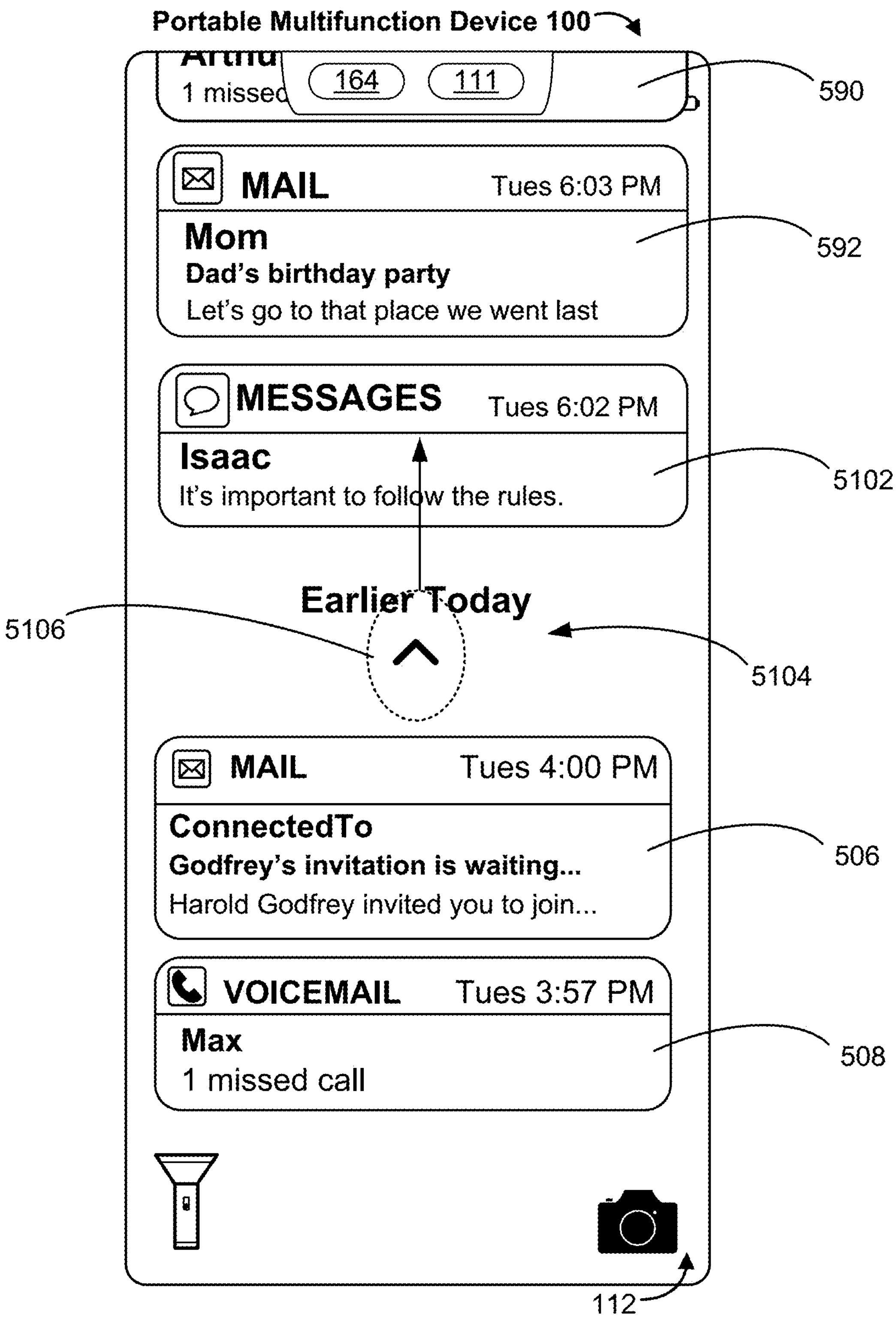

Portable Multifunction Device 100
Arthu
1 missed
164
111
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
5106
5104
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
112

Figure 5BL

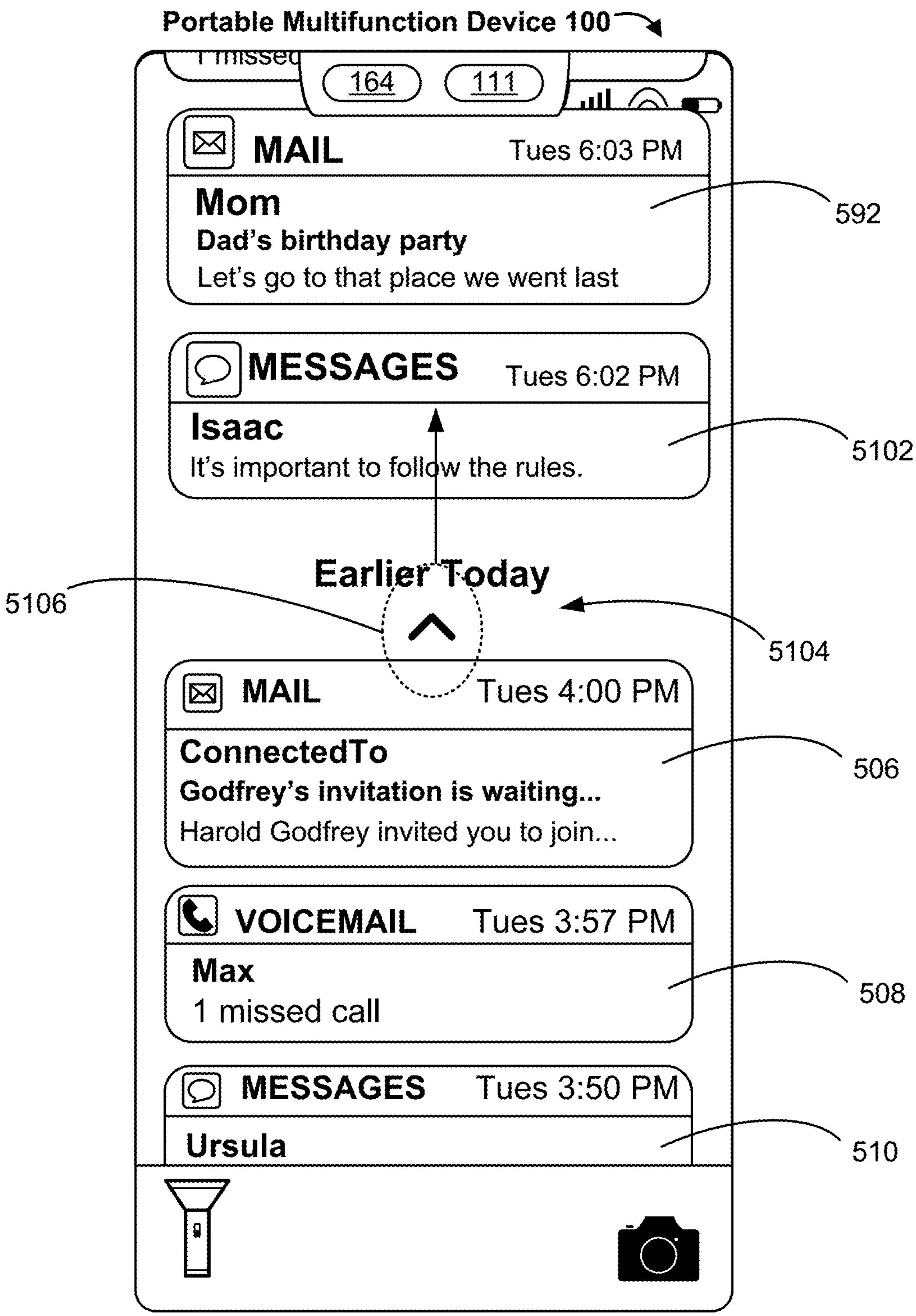

Portable Multifunction Device 100
1 missed
164
111
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
5106
5104
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MESSAGES
Tues 3:50 PM
Ursula
510

Figure 5BM

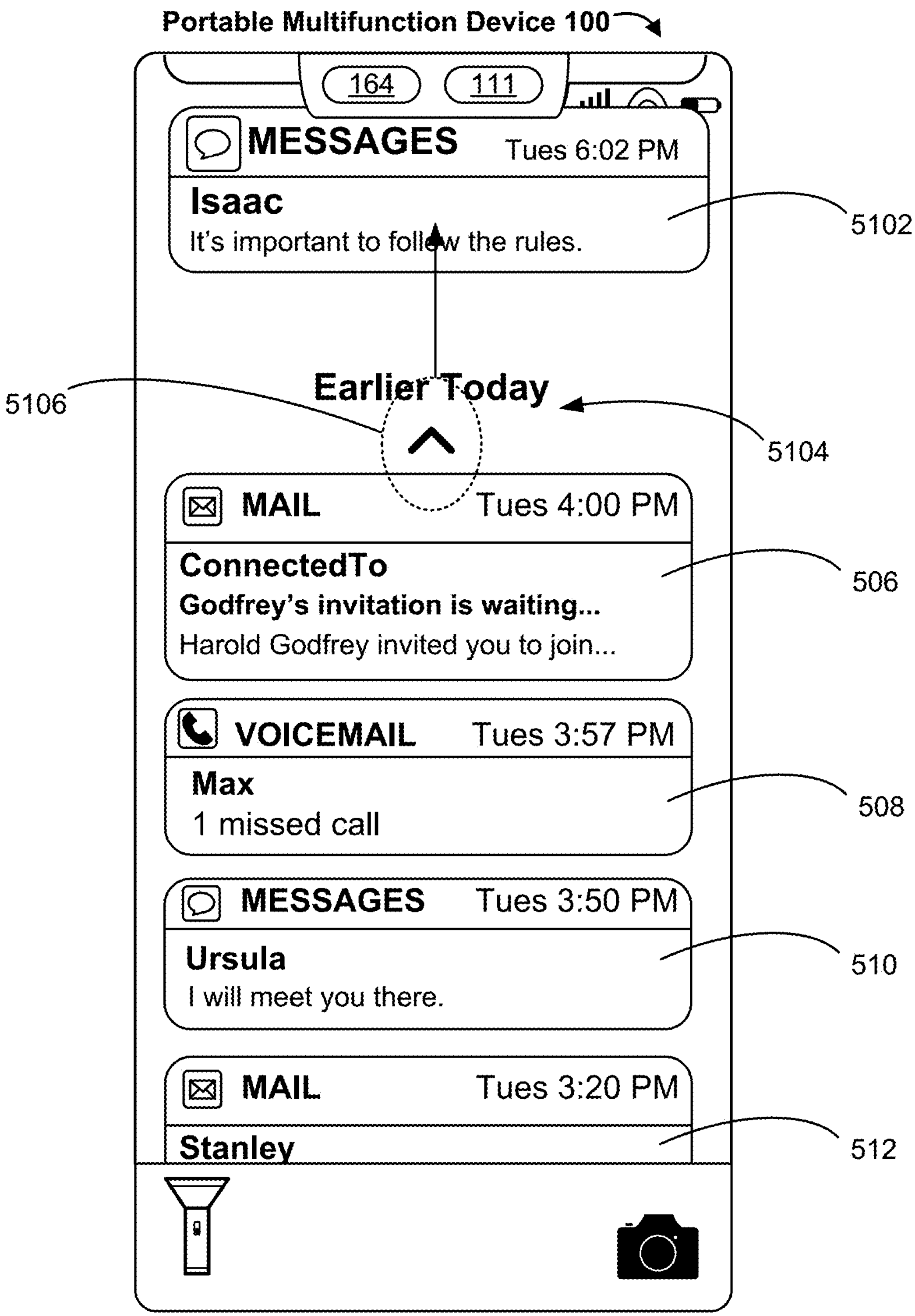

Portable Multifunction Device 100
164
111
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
5106
Earlier Today
5104
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM
Stanley
512

Figure 5BN

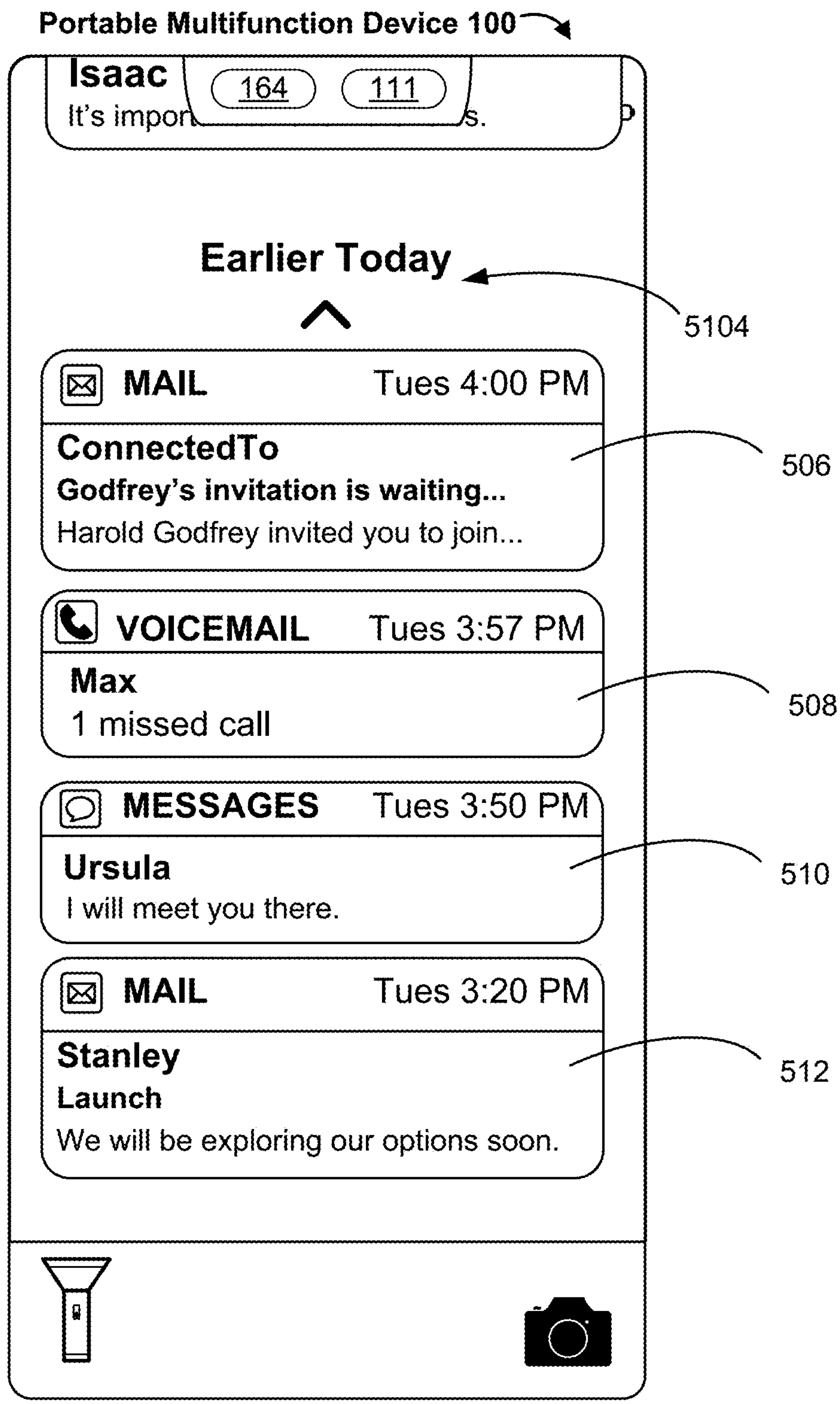

Portable Multifunction Device 100
Isaac
164
111
It's impor
s.
Earlier Today
5104
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
512

Figure 5BO

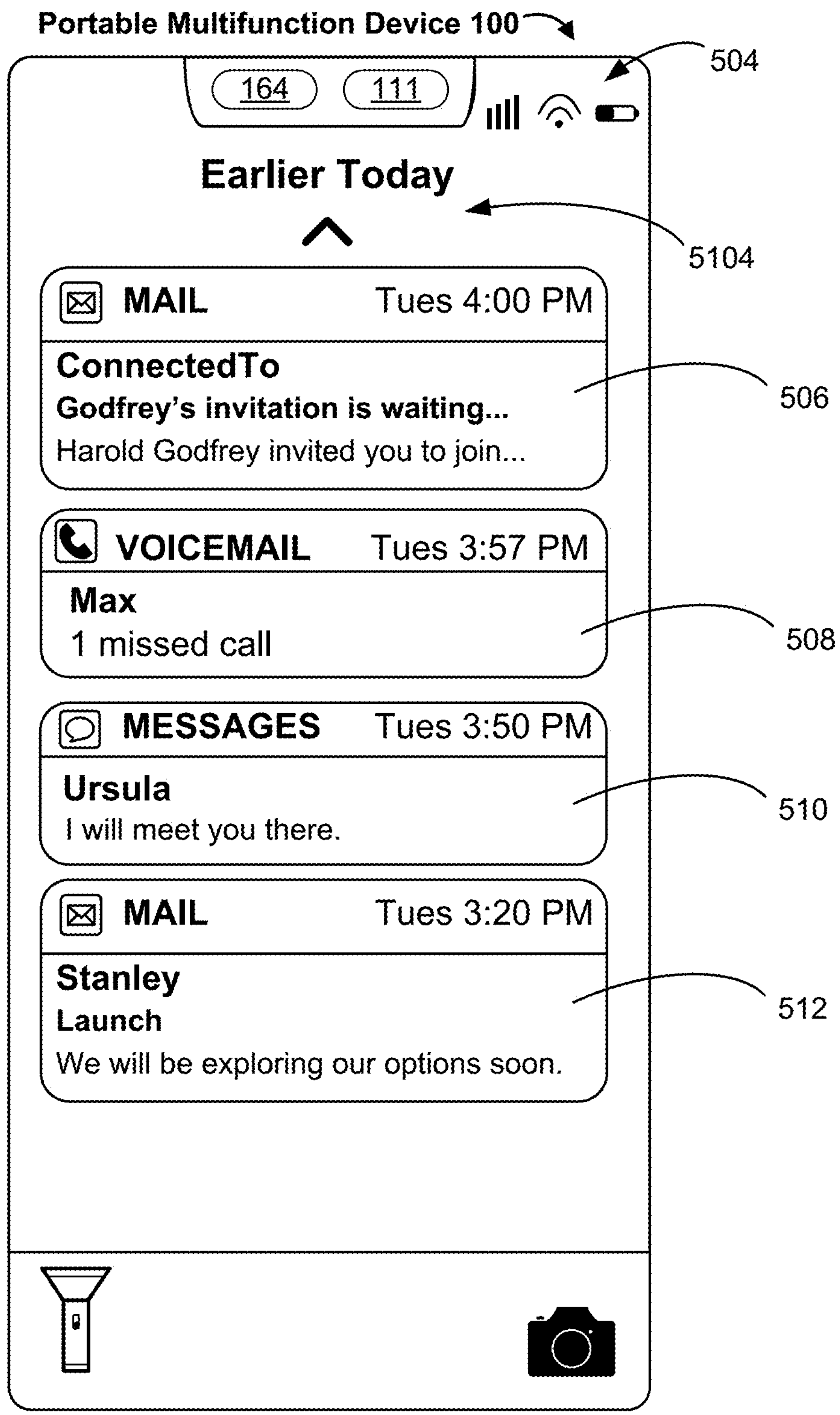
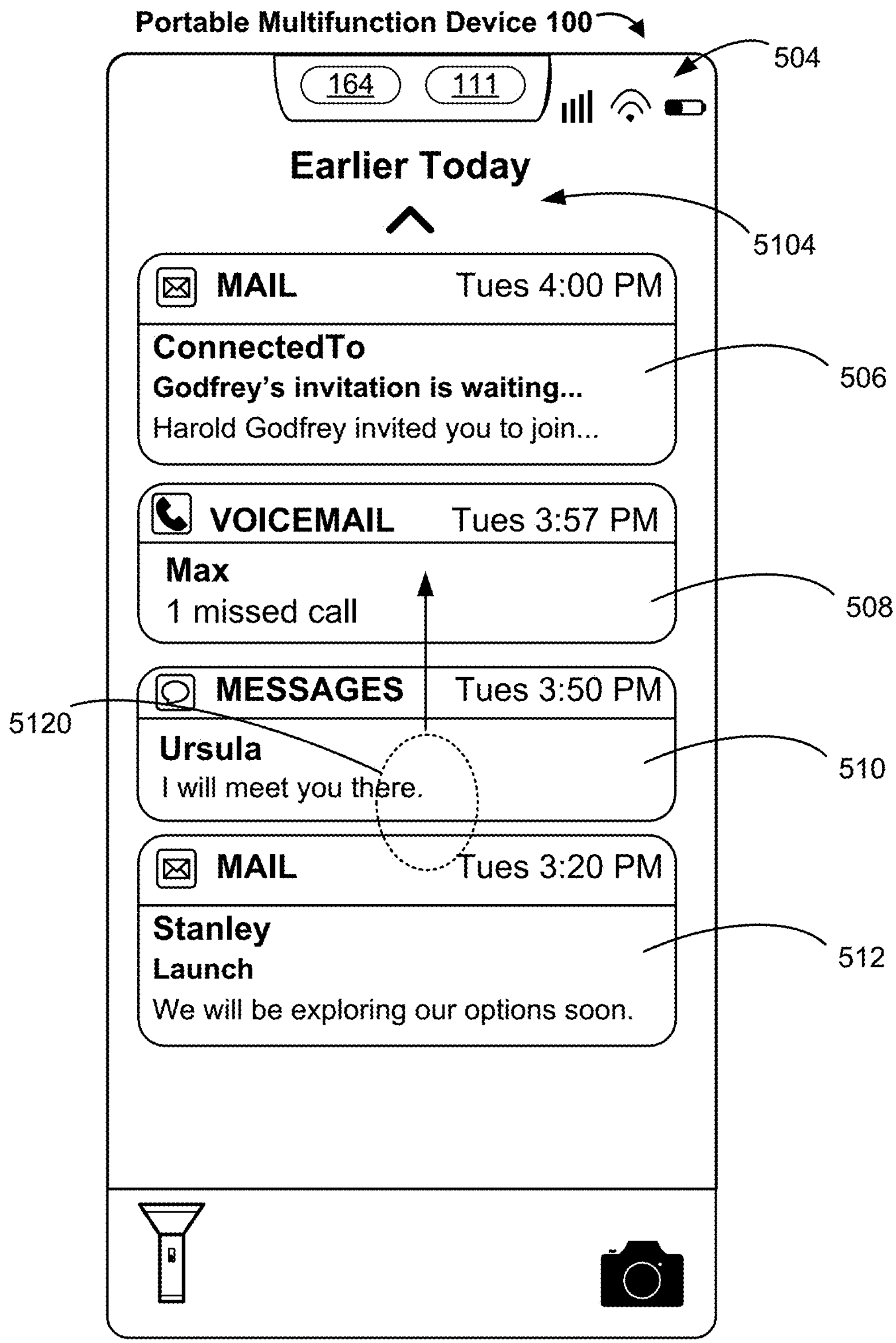
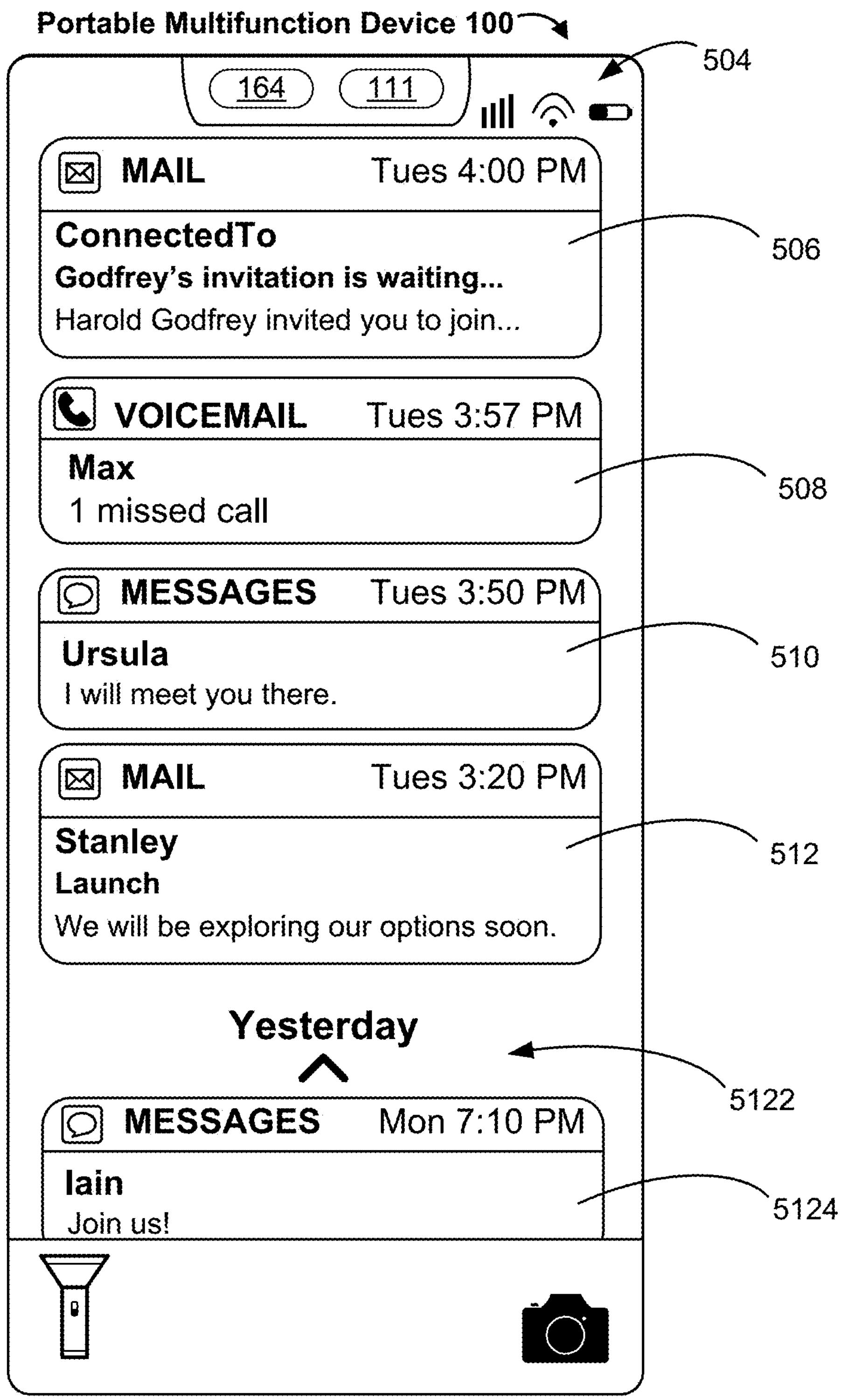

Portable Multifunction Device 100
504
164
111
Earlier Today
5104
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
512

Figure 5BP



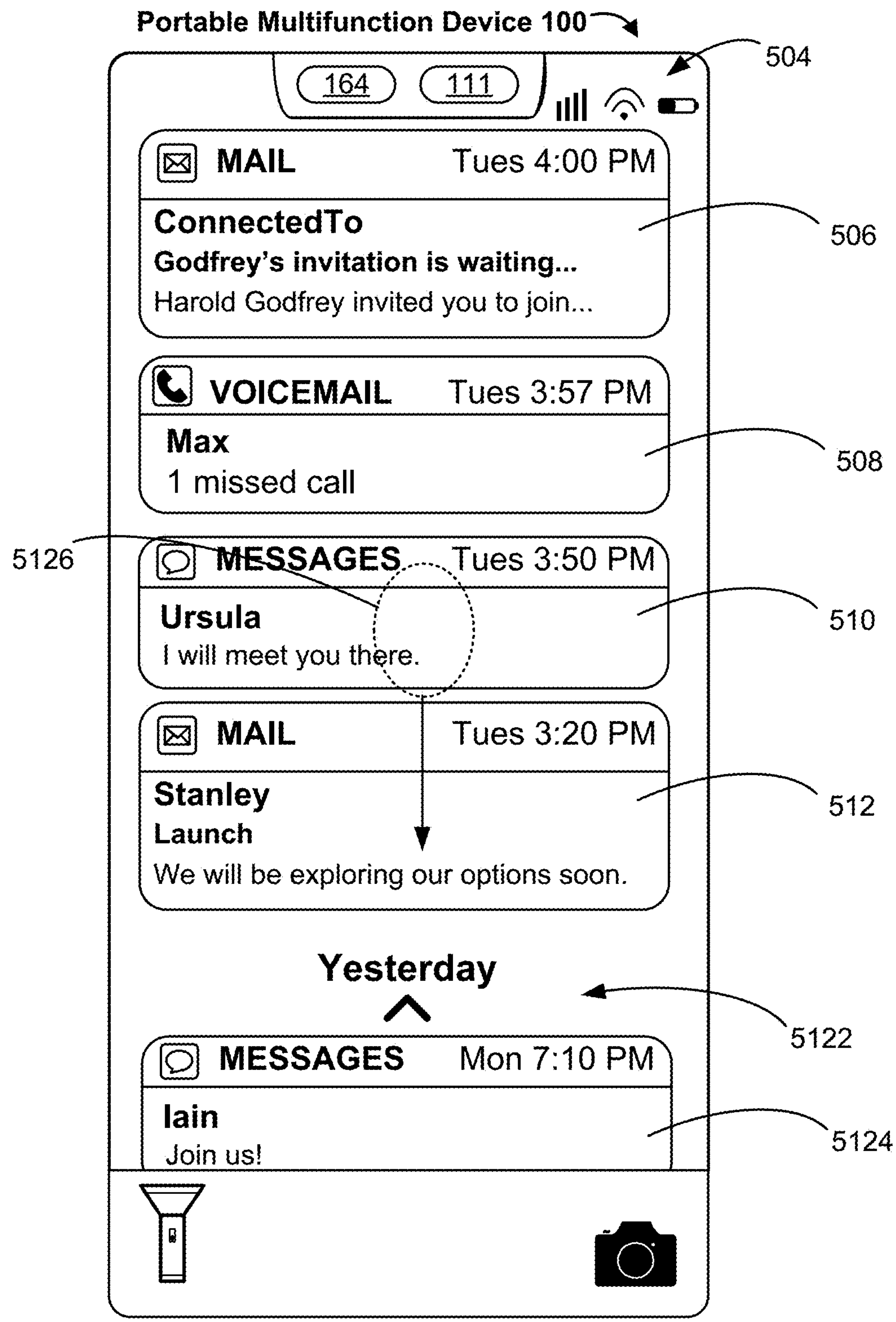
Portable Multifunction Device 100
504
164
111
Earlier Today
5104
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
5120
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
512

Figure 5BQ



Portable Multifunction Device 100
504
164
111
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
512
Yesterday
5122
MESSAGES
Mon 7:10 PM
Iain
Join us!
5124

Figure 5BR



Portable Multifunction Device 100
504
164
111
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
5126
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM
Stanley
Launch
We will be exploring our options soon.
512
Yesterday
5122
MESSAGES
Mon 7:10 PM
Iain
Join us!
5124

Figure 5BS

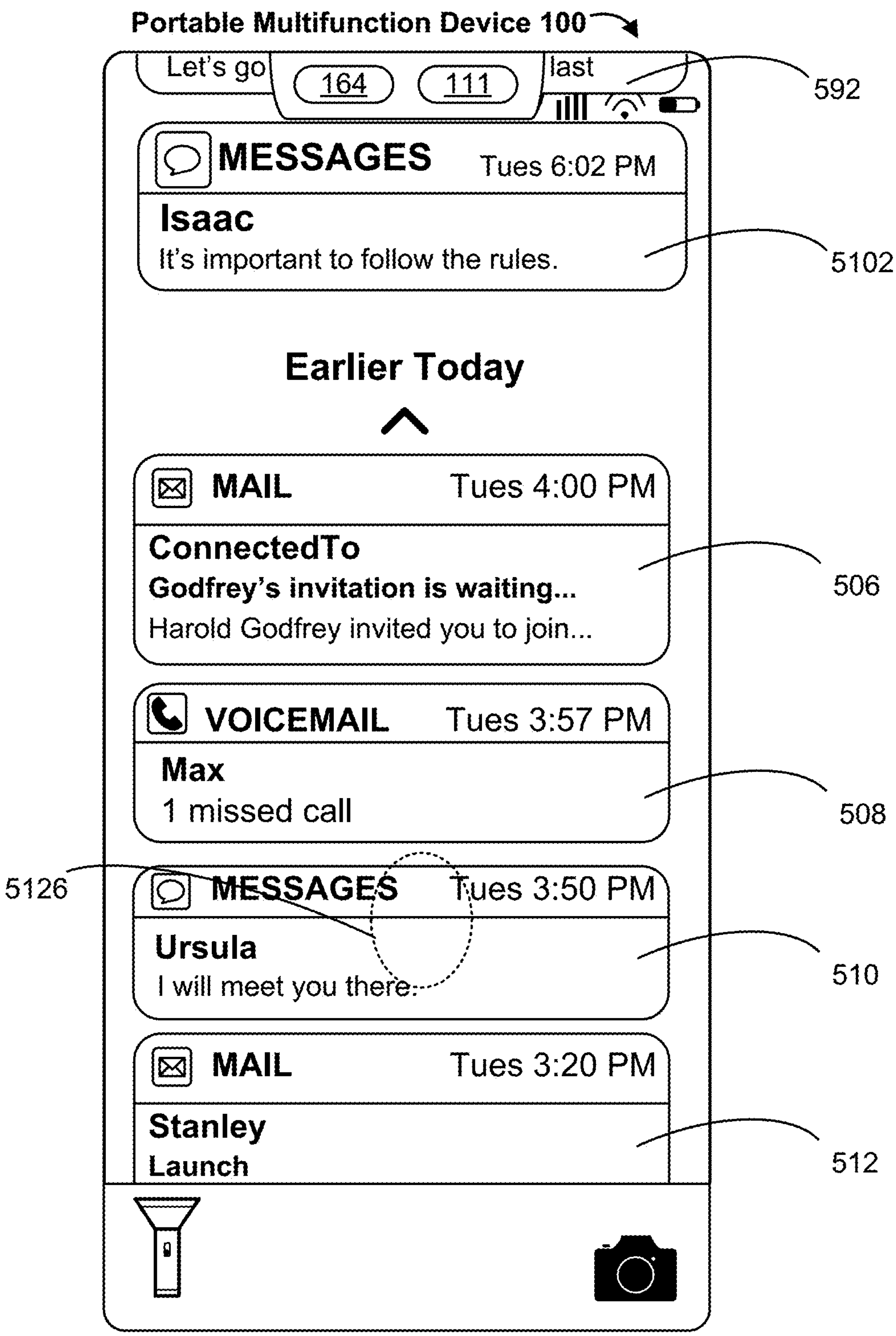
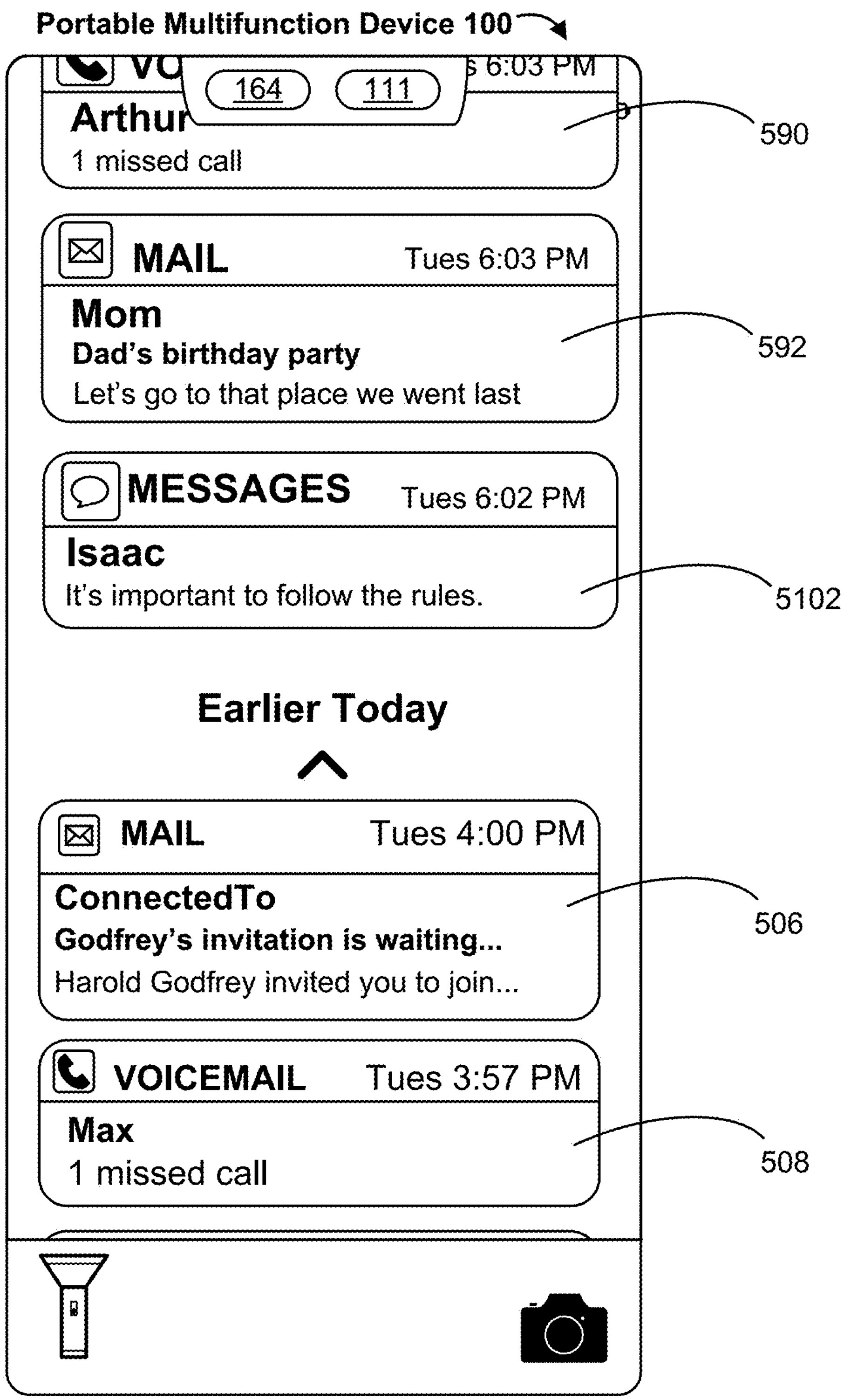
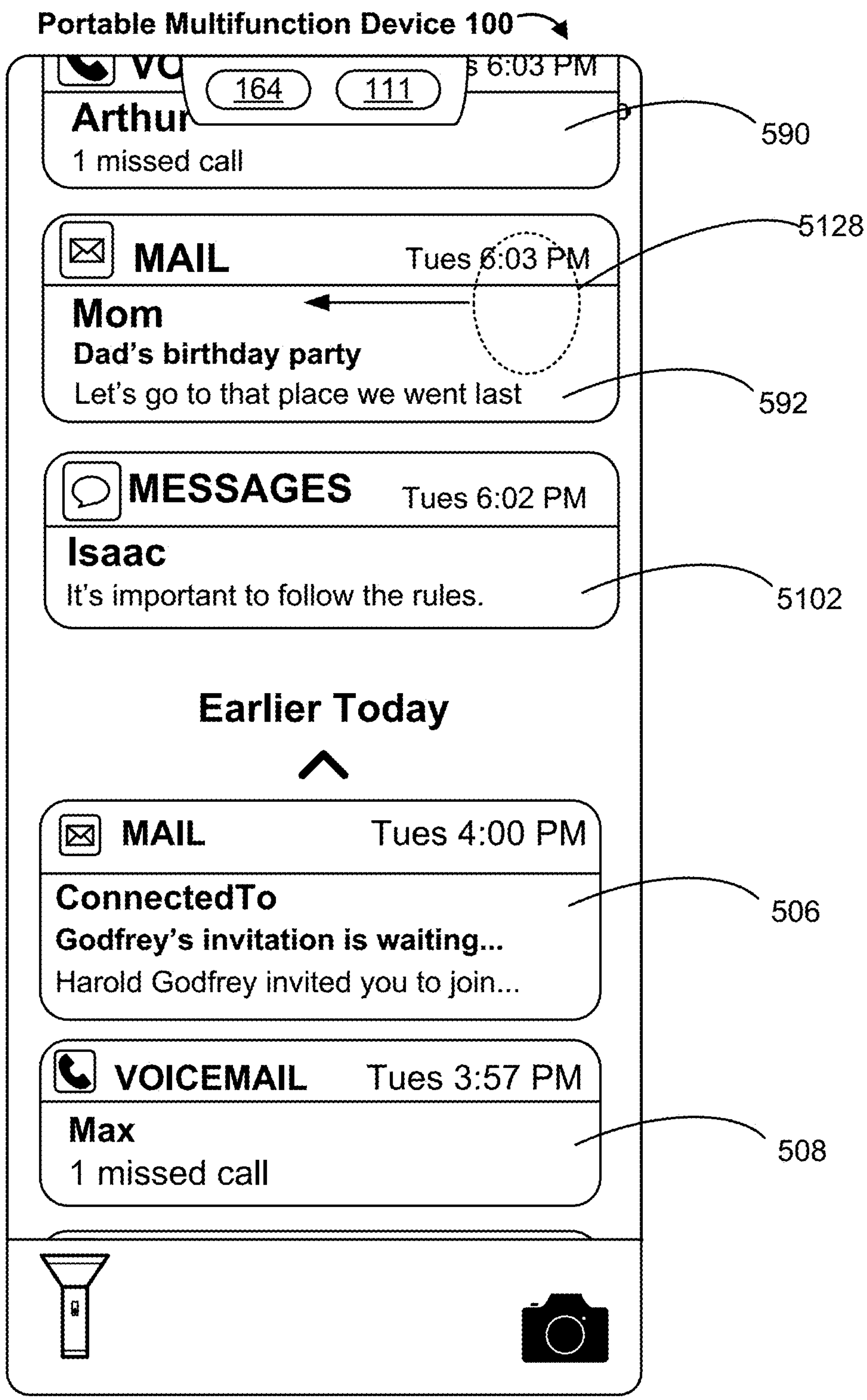

Portable Multifunction Device 100
Let's go
164
111
last
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
5126
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM
Stanley
Launch
512

Figure 5BT



Portable Multifunction Device 100
VO
164
111
s 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
Dad's birthday party
Let's go to that place we went last
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508

Figure 5BU



Portable Multifunction Device 100
VO
164
111
s 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
5128
Mom
Dad's birthday party
Let's go to that place we went last
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508

Figure 5BV

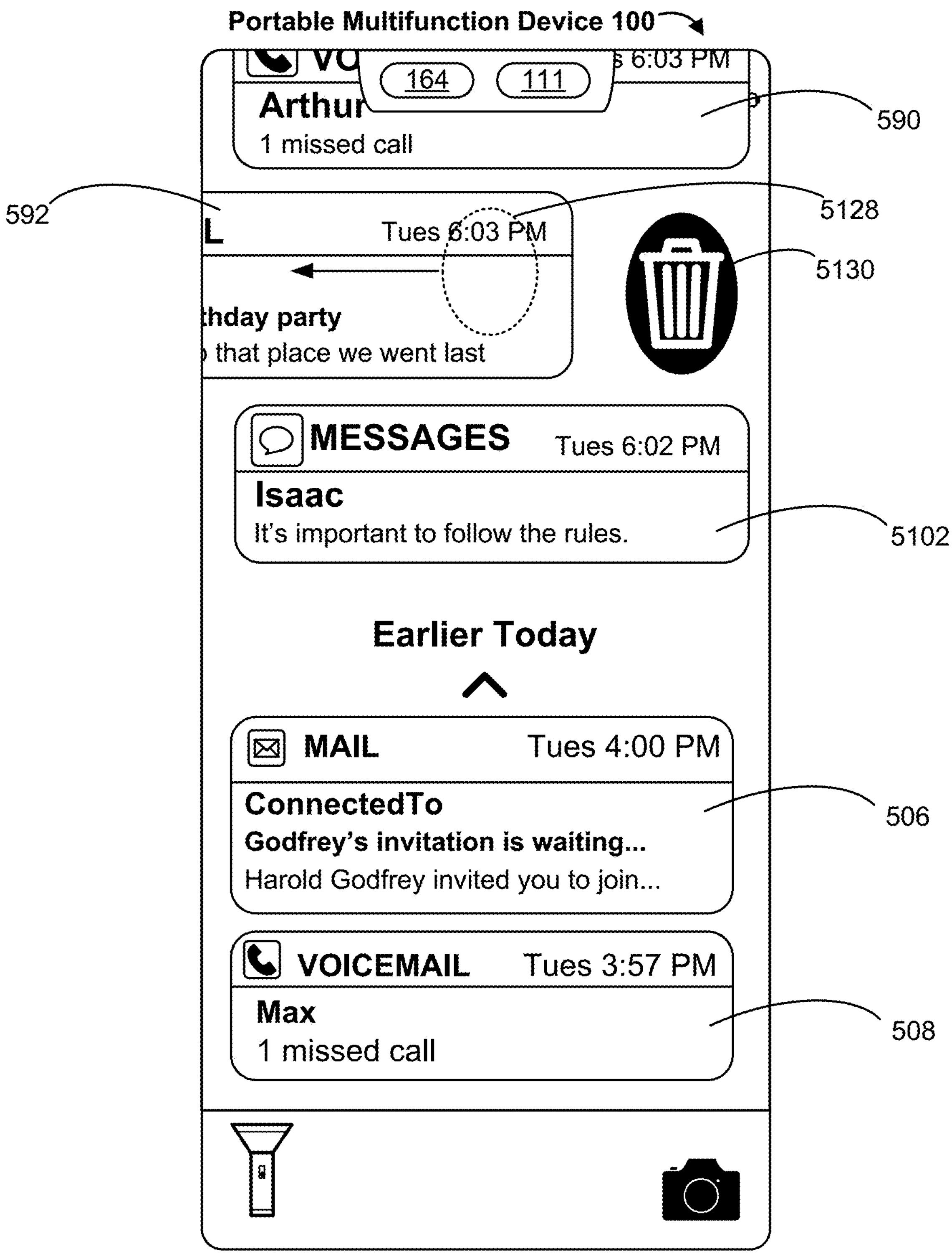
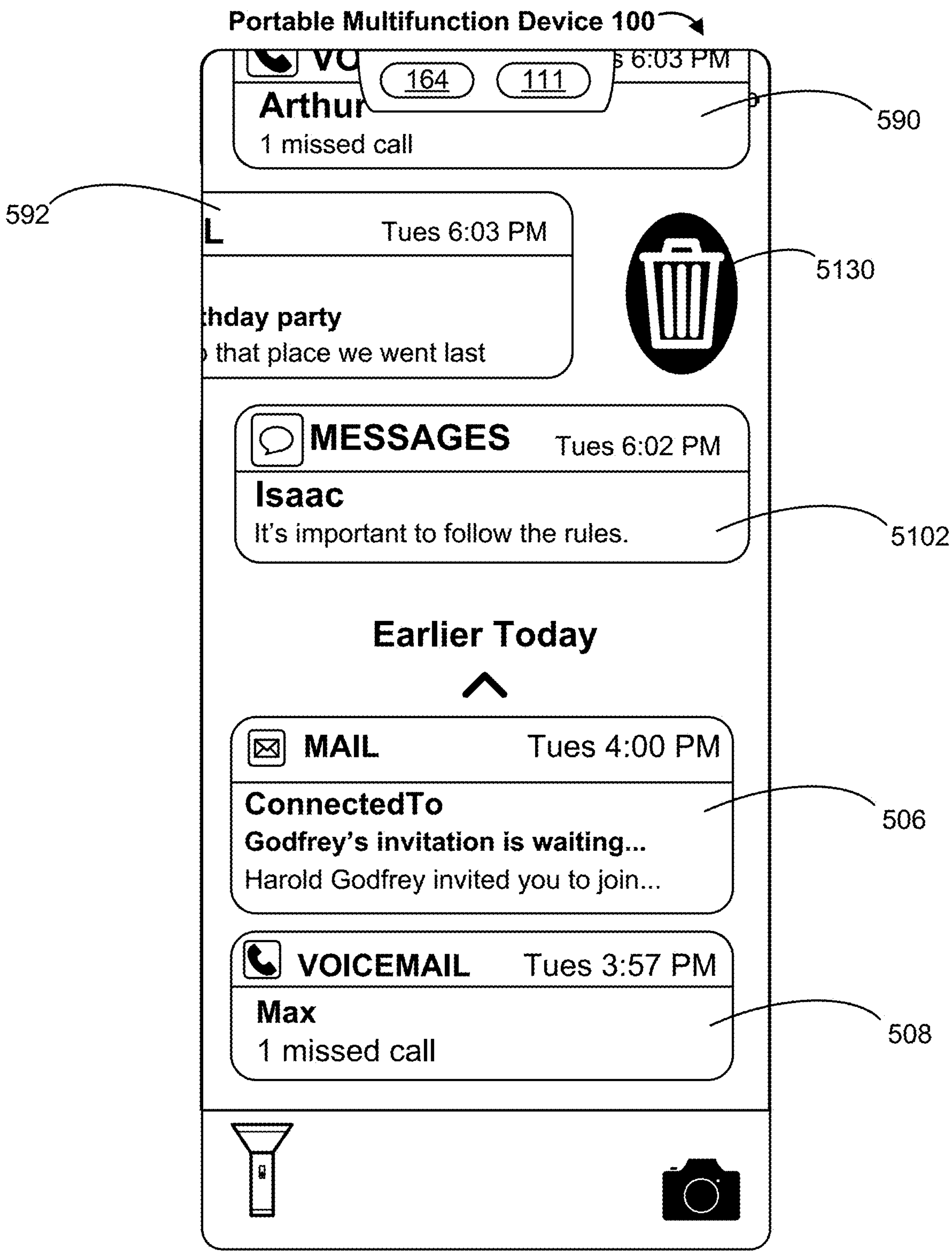
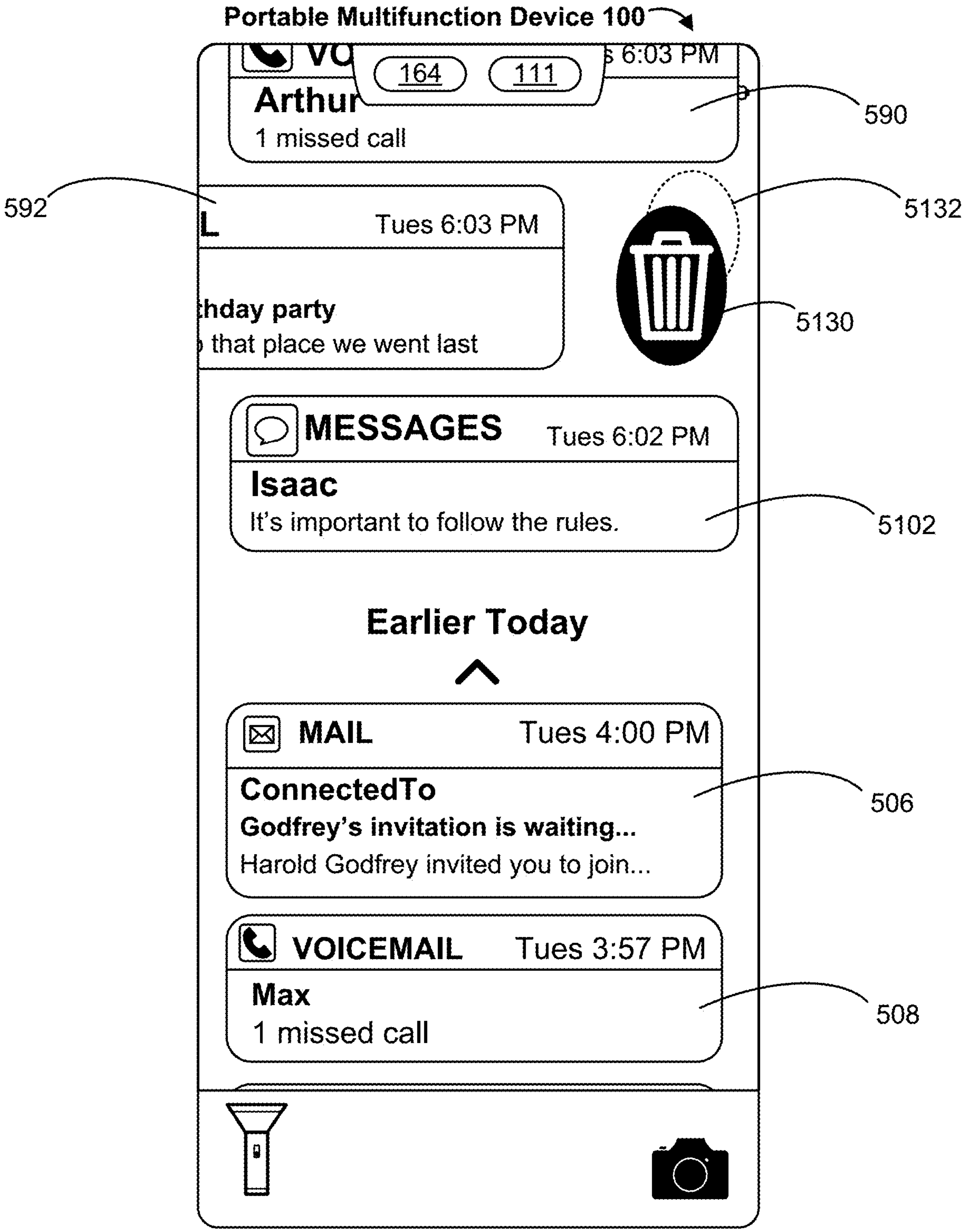

Portable Multifunction Device 100
VO
164
111
6:03 PM
Arthur
1 missed call
590
592
L
Tues 6:03 PM
5128
5130
thday party
that place we went last
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508

Figure 5BW



Portable Multifunction Device 100
VO
164
111
s 6:03 PM
Arthur
1 missed call
590
592
L
Tues 6:03 PM
thday party
that place we went last
5130
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508

Figure 5BX



Portable Multifunction Device 100
VO
s 6:03 PM
164
111
Arthur
1 missed call
590
592
L
Tues 6:03 PM
thday party
that place we went last
5132
5130
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508

Figure 5BY

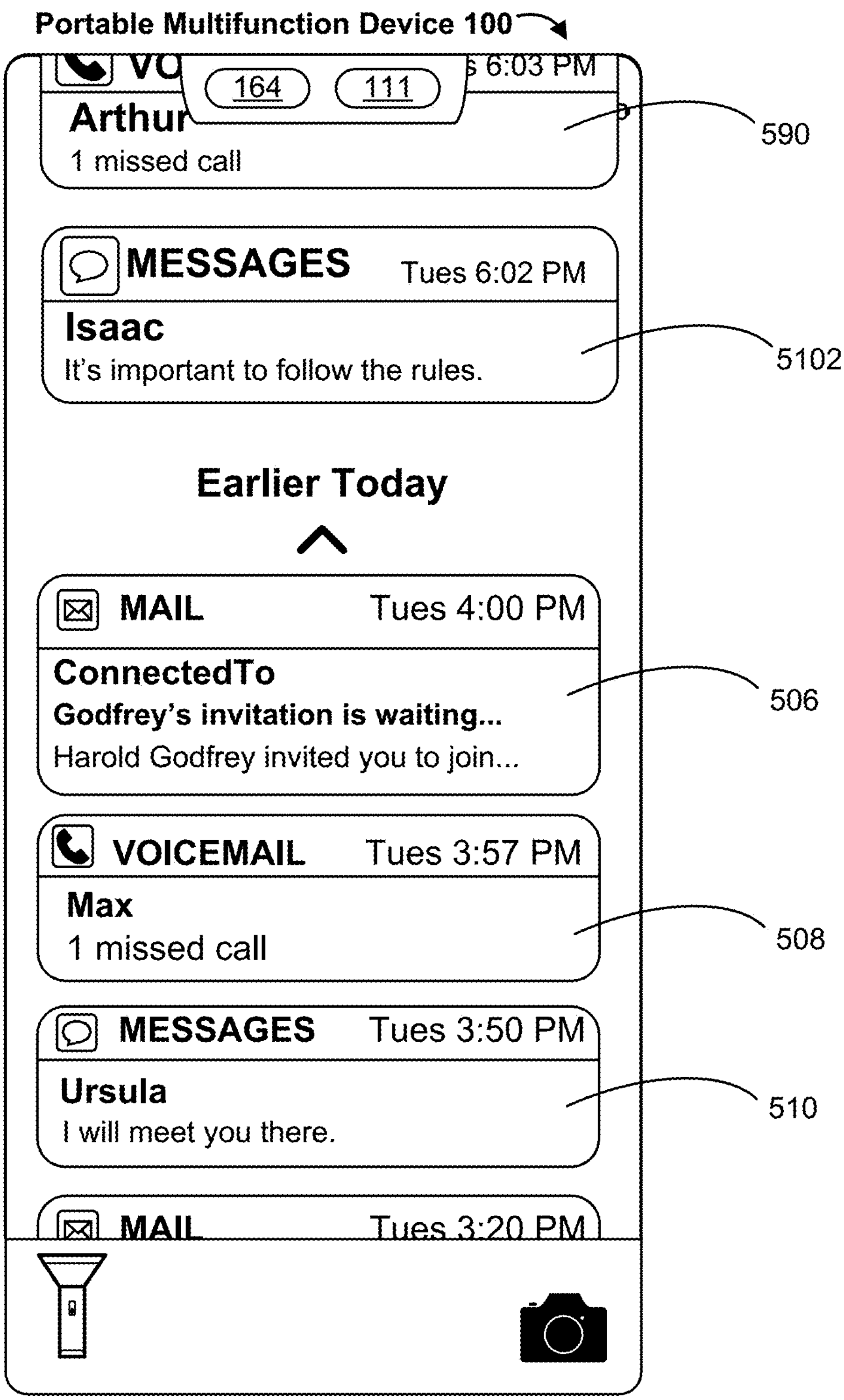

Portable Multifunction Device 100
VO
s 6:03 PM
164
111
Arthur
1 missed call
590
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM

Figure 5BZ

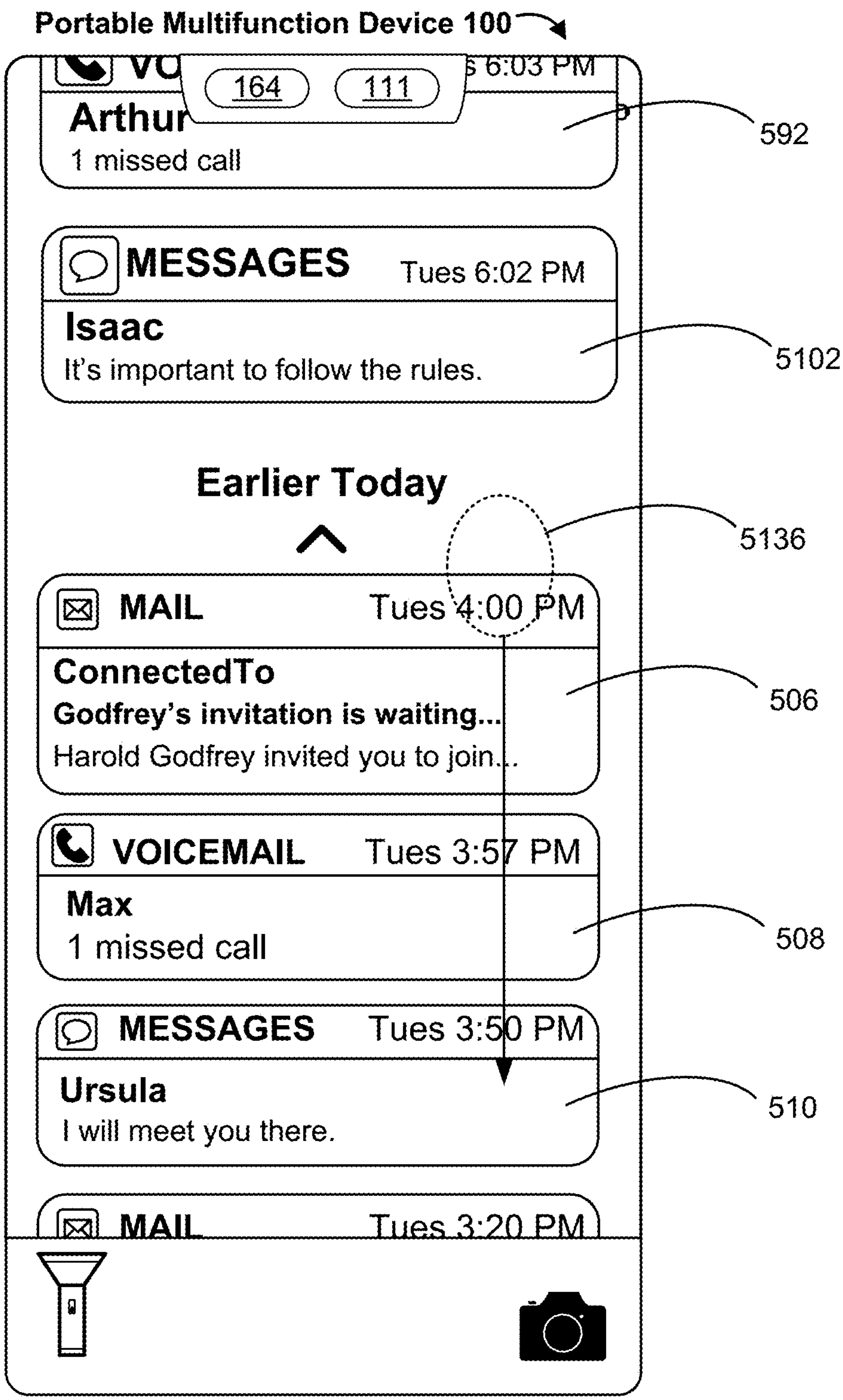

Portable Multifunction Device 100
VO
s 6:03 PM
164
111
Arthur
1 missed call
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
Earlier Today
5136
MAIL
Tues 4:00 PM
ConnectedTo
Godfrey's invitation is waiting...
Harold Godfrey invited you to join...
506
VOICEMAIL
Tues 3:57 PM
Max
1 missed call
508
MESSAGES
Tues 3:50 PM
Ursula
I will meet you there.
510
MAIL
Tues 3:20 PM

Figure 5CA

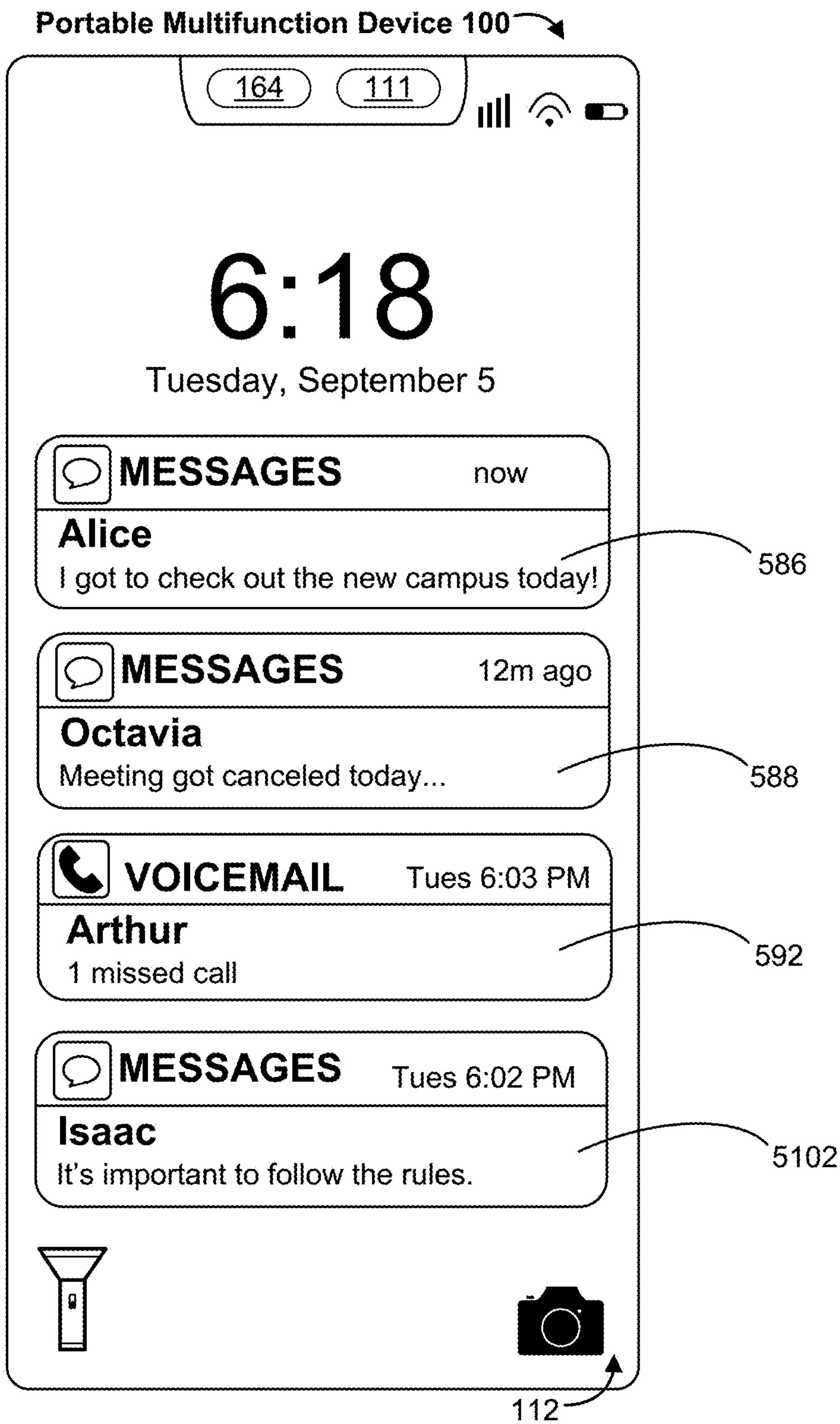
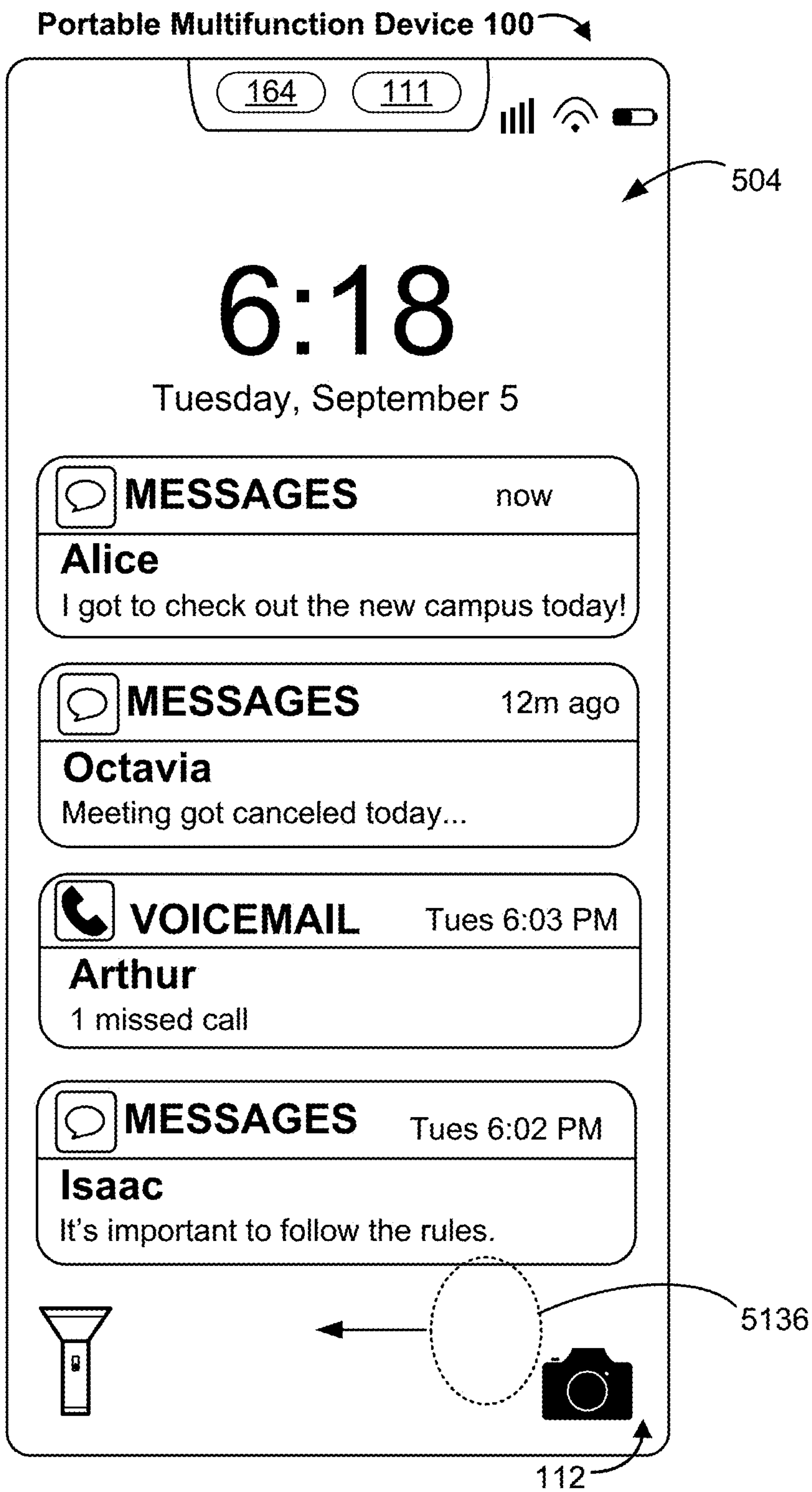
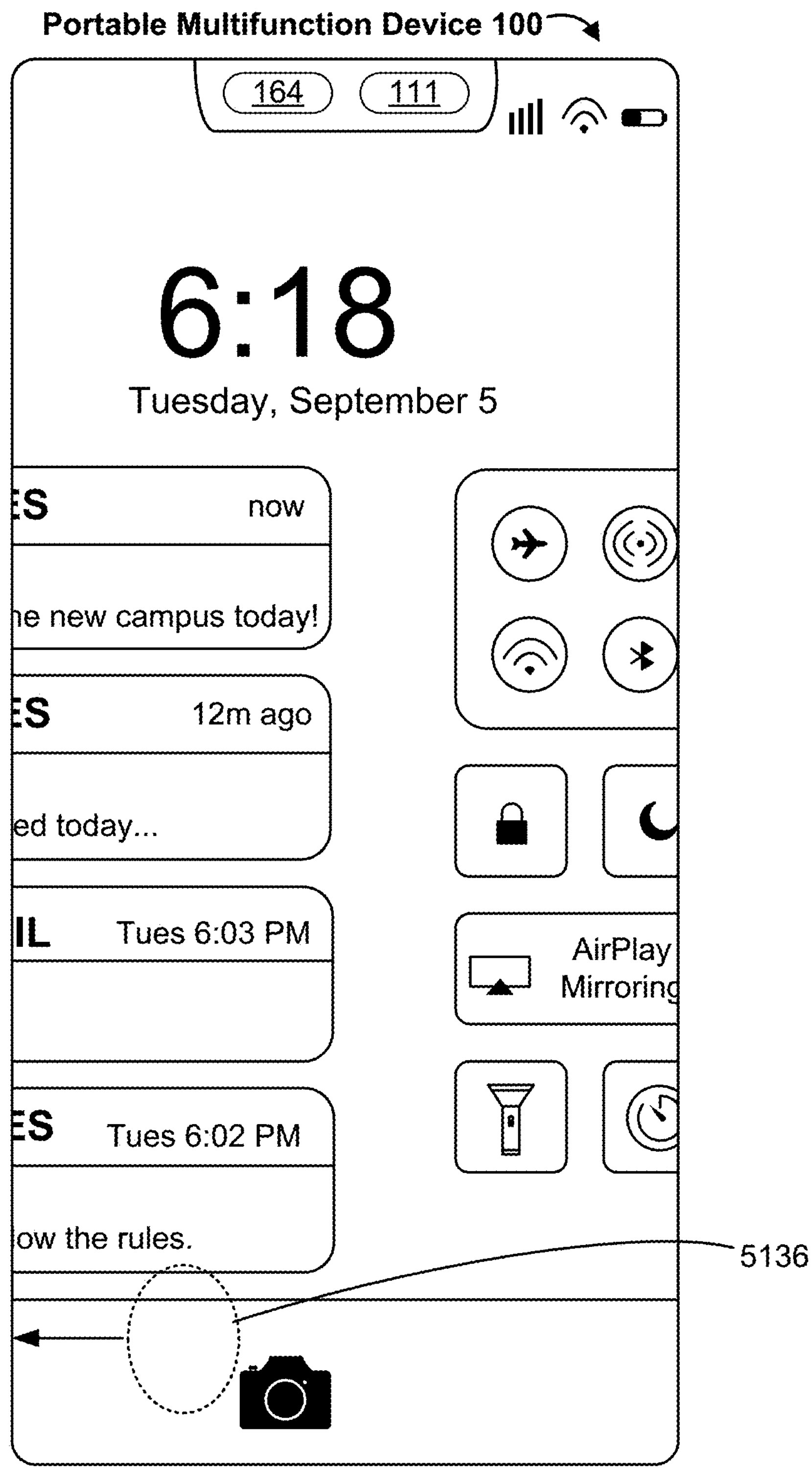

Portable Multifunction Device 100
164
111
6:18
Tuesday, September 5
MESSAGES
now
Alice
I got to check out the new campus today!
586
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
592
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5102
112

Figure 5CB



Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
MESSAGES
now
Alice
I got to check out the new campus today!
MESSAGES
12m ago
Octavia
Meeting got canceled today...
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5136
112

Figure 5CC



Portable Multifunction Device 100
164
111
6:18
Tuesday, September 5
ES
now
ne new campus today!
ES
12m ago
ed today...
IL
Tues 6:03 PM
ES
Tues 6:02 PM
ow the rules.
AirPlay
Mirroring
5136

Figure 5CD


Portable Multifunction Device 100
164
111
5138
6:18
Tuesday, September 5
Surface
Bonobo
AirPlay
Mirroring
112

Figure 5CE


Portable Multifunction Device 100
164
111
5138
6:18
Tuesday, September 5
Surface
Bonobo
AirPlay
Mirroring
5142
112

Figure 5CF

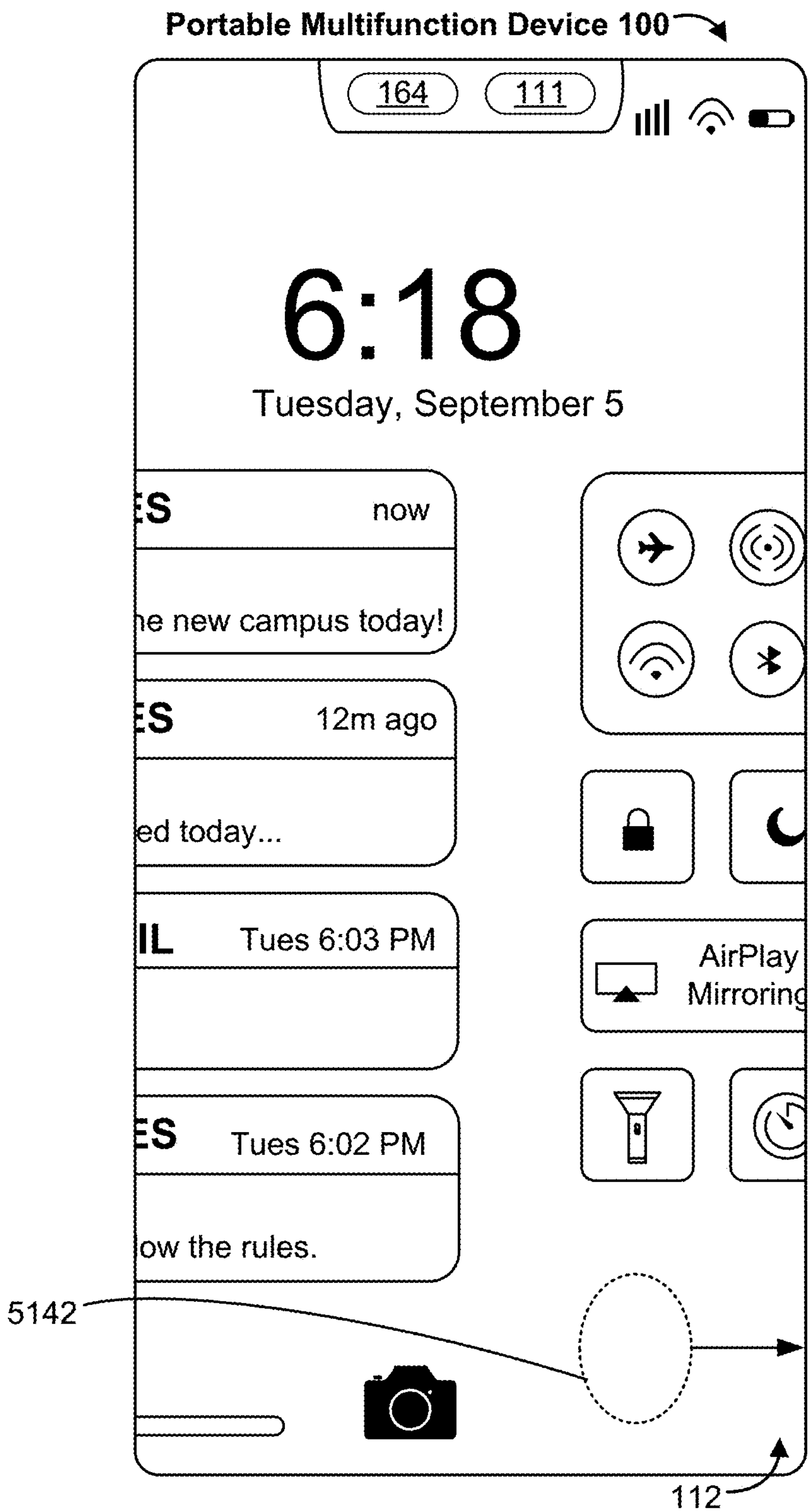
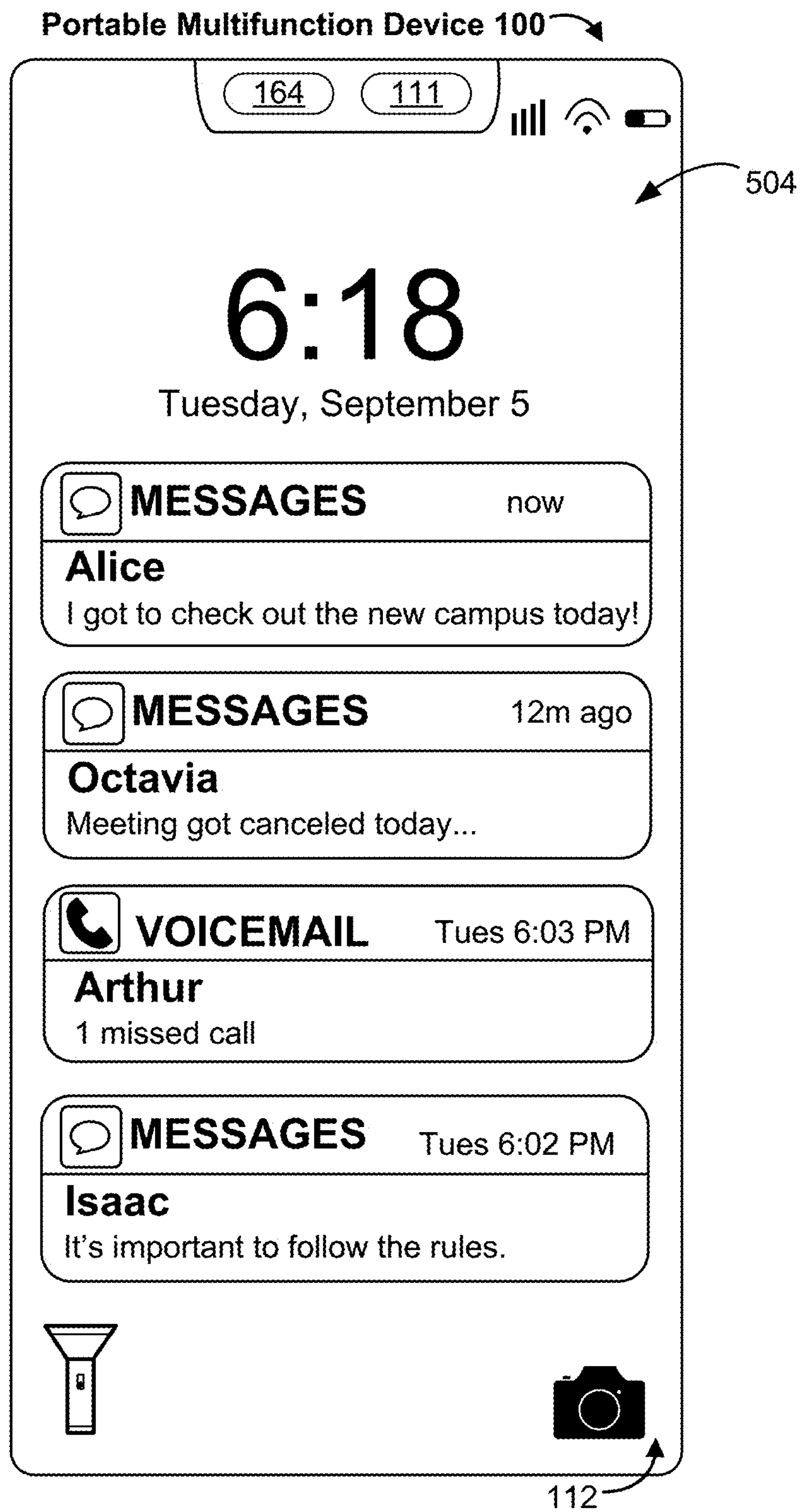

Portable Multifunction Device 100
164
111
6:18
Tuesday, September 5
ES
now
ne new campus today!
ES
12m ago
ed today...
IL
Tues 6:03 PM
ES
Tues 6:02 PM
ow the rules.
AirPlay
Mirroring
5142
112

Figure 5CG



Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
MESSAGES
now
Alice
I got to check out the new campus today!
MESSAGES
12m ago
Octavia
Meeting got canceled today...
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
112

Figure 5CH

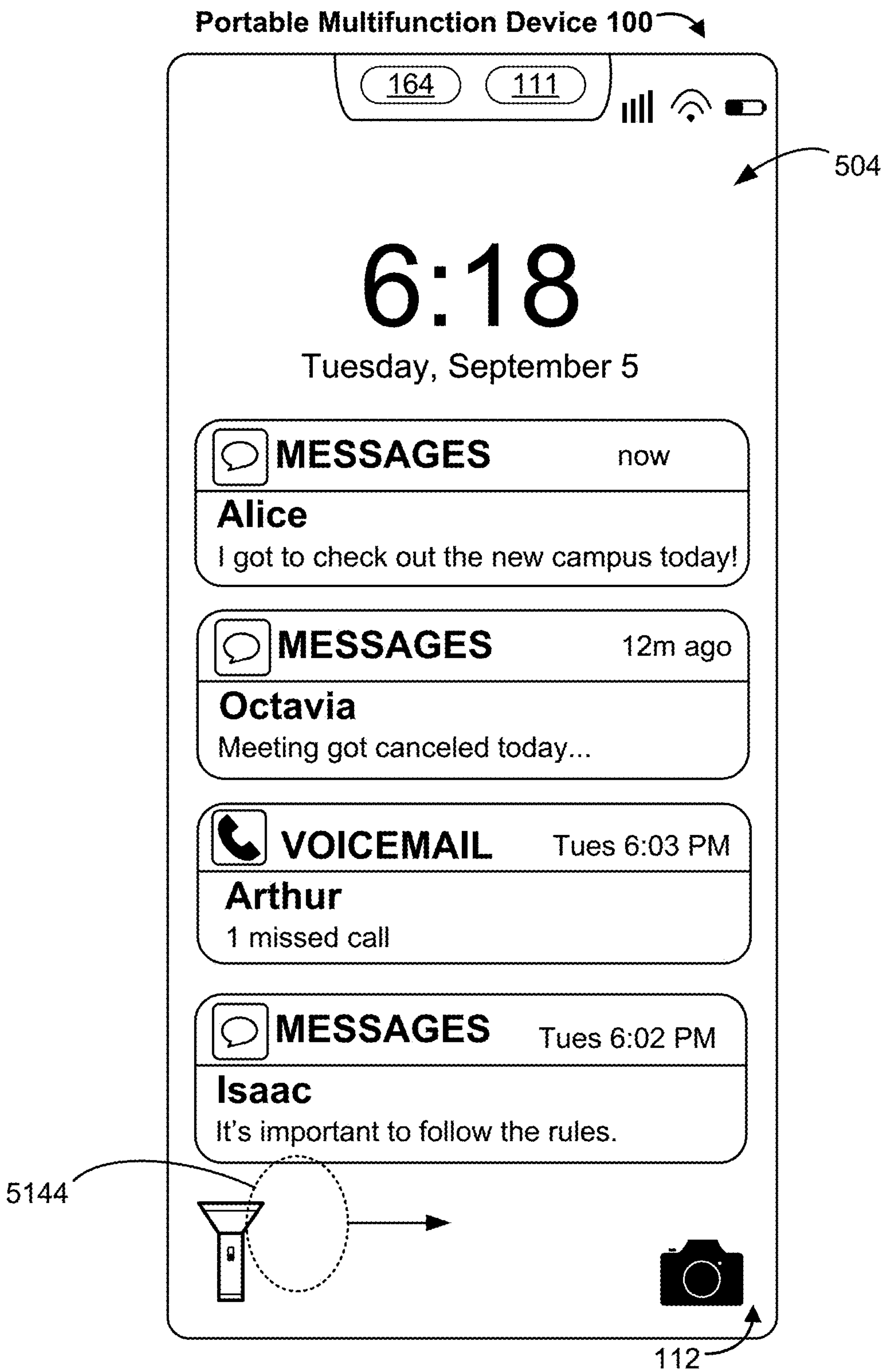
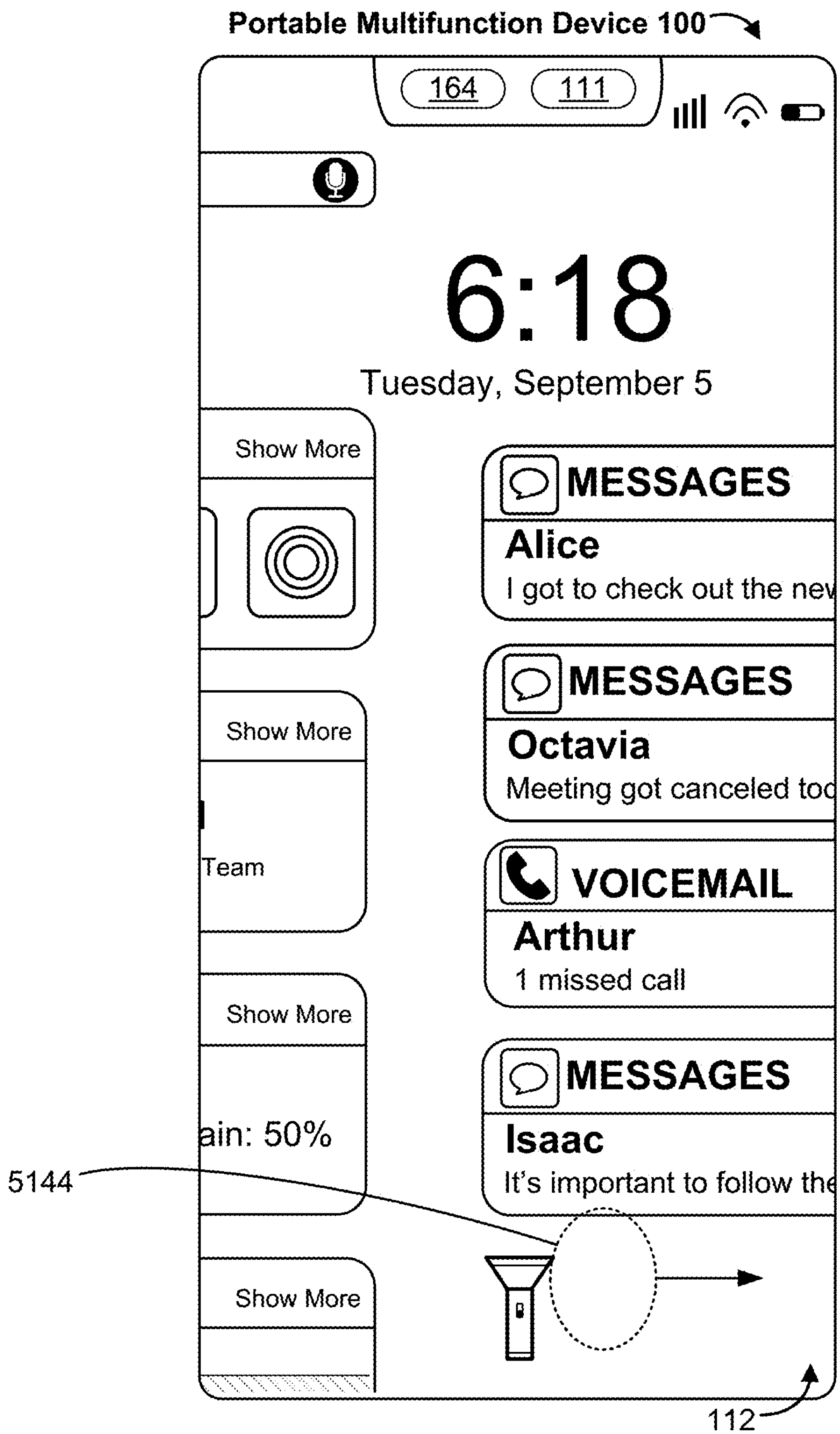

Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
MESSAGES
now
Alice
I got to check out the new campus today!
MESSAGES
12m ago
Octavia
Meeting got canceled today...
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5144
112

Figure 5CI



Portable Multifunction Device 100
164
111
6:18
Tuesday, September 5
Show More
MESSAGES
Alice
I got to check out the nev
Show More
MESSAGES
Octavia
Meeting got canceled tod
Team
VOICEMAIL
Arthur
1 missed call
Show More
MESSAGES
Isaac
It's important to follow the
ain: 50%
5144
Show More
112

Figure 5CJ

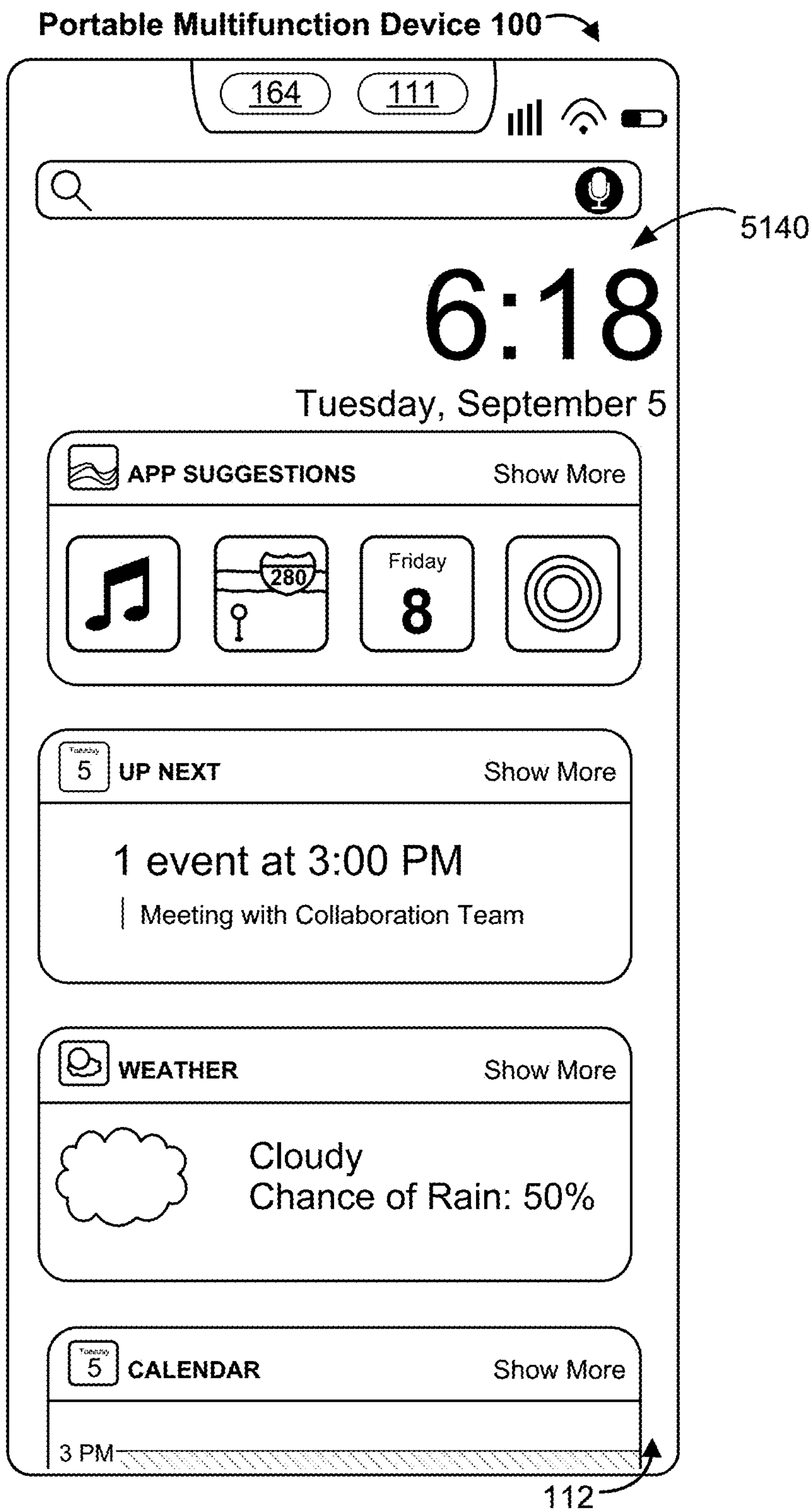
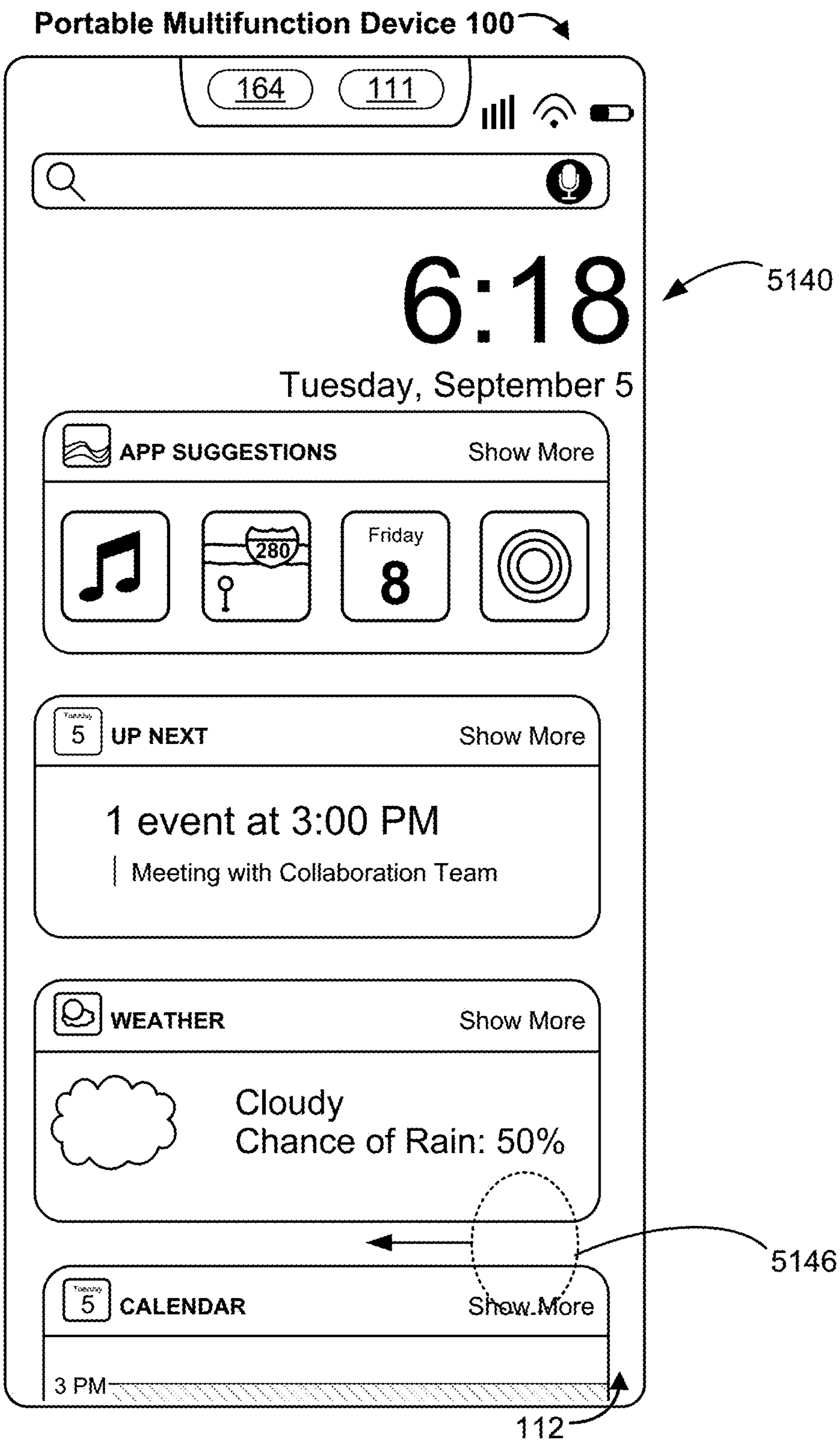
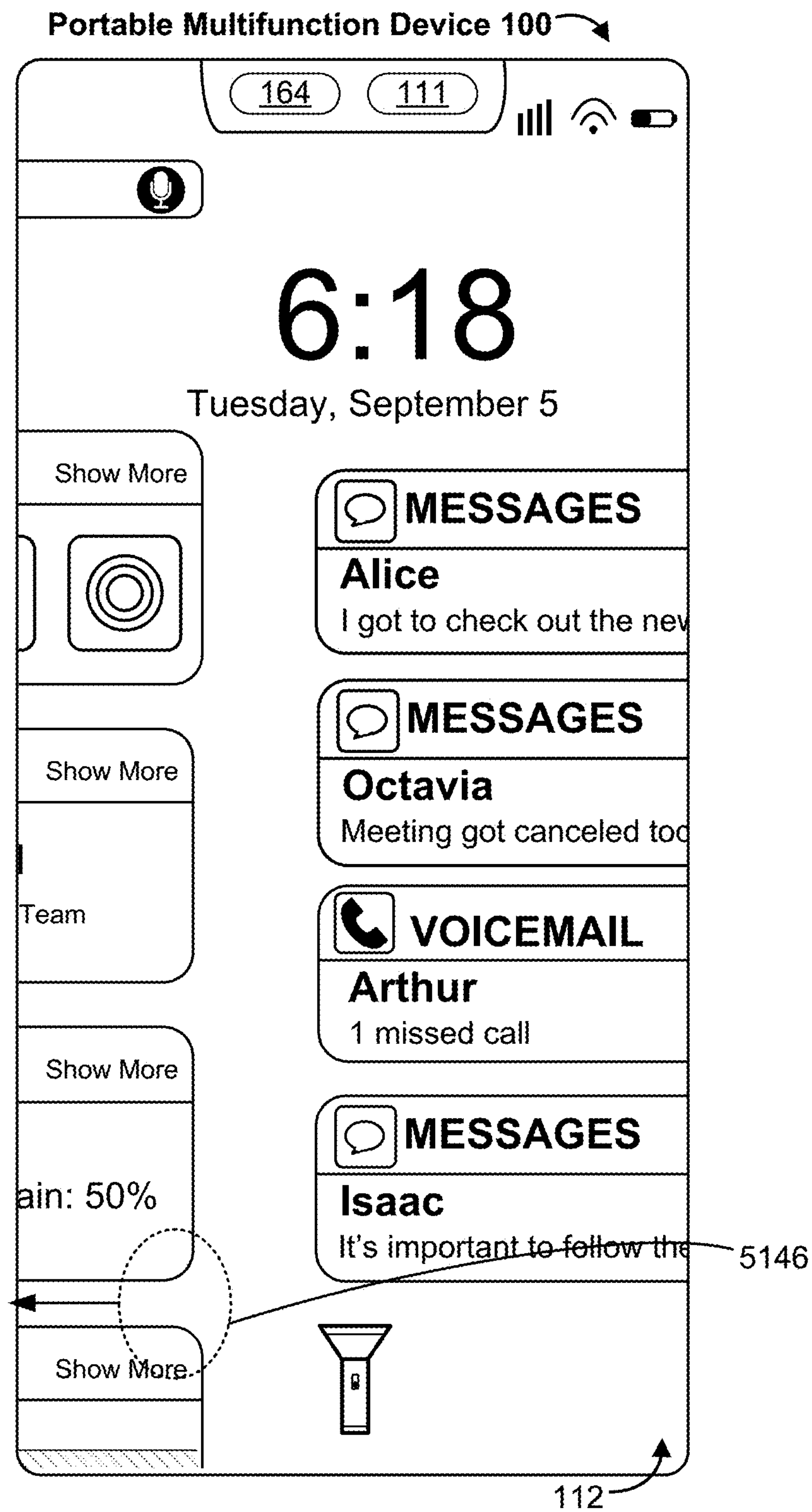

Portable Multifunction Device 100
164
111
5140
6:18
Tuesday, September 5
APP SUGGESTIONS
Show More
280
Friday
8
5
UP NEXT
Show More
1 event at 3:00 PM
Meeting with Collaboration Team
WEATHER
Show More
Cloudy
Chance of Rain: 50%
5
CALENDAR
Show More
3 PM
112

Figure 5CK



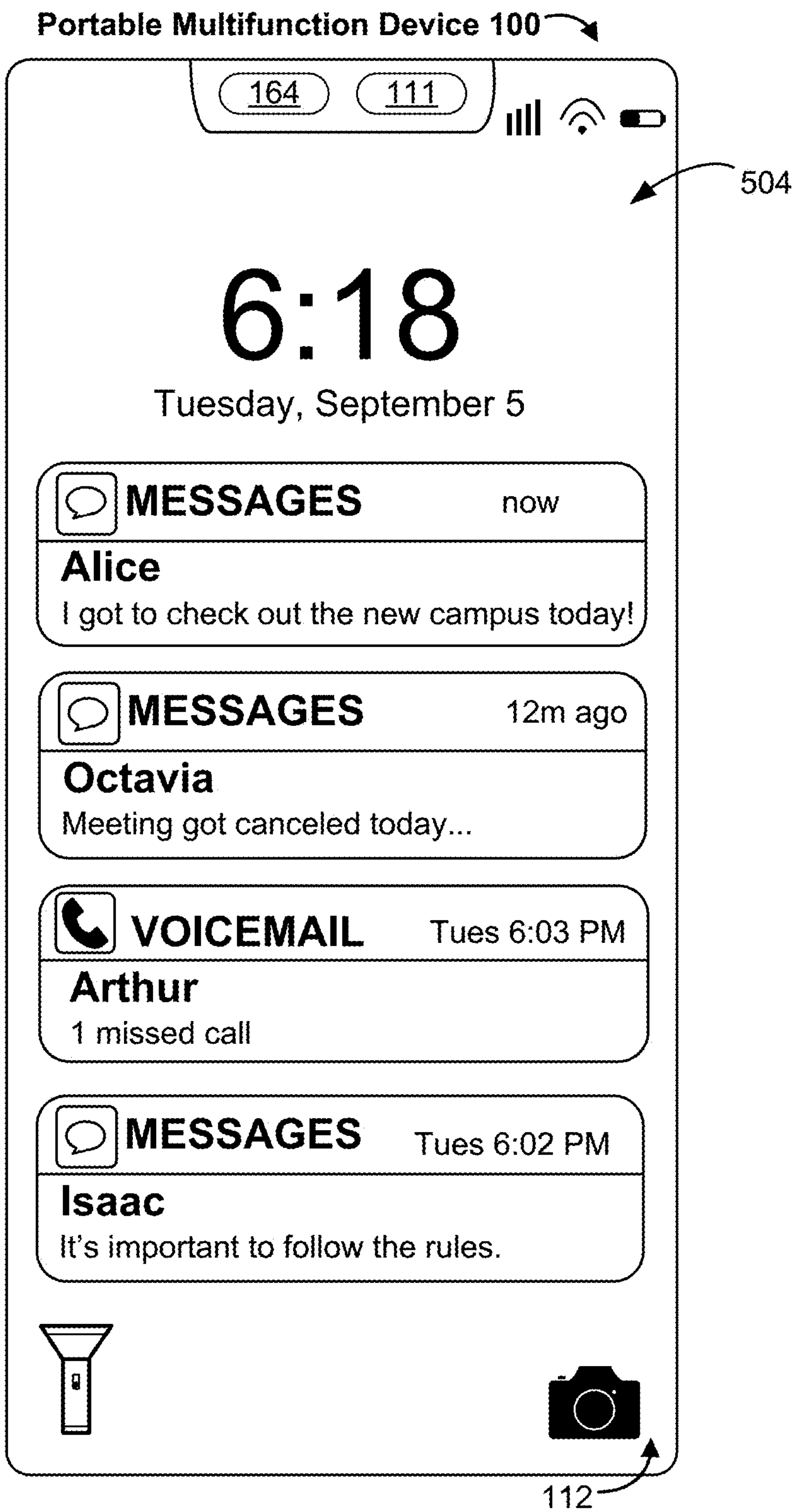
Portable Multifunction Device 100
164
111
6:18
5140
Tuesday, September 5
APP SUGGESTIONS
Show More
280
Friday
8
5
UP NEXT
Show More
1 event at 3:00 PM
Meeting with Collaboration Team
WEATHER
Show More
Cloudy
Chance of Rain: 50%
5146
5
CALENDAR
Show More
3 PM
112

Figure 5CL



Portable Multifunction Device 100
164
111
6:18
Tuesday, September 5
Show More
MESSAGES
Alice
I got to check out the nev
MESSAGES
Octavia
Meeting got canceled toc
Show More
Team
VOICEMAIL
Arthur
1 missed call
Show More
ain: 50%
MESSAGES
Isaac
It's important to follow the
5146
Show More
112

Figure 5CM



Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
MESSAGES
now
Alice
I got to check out the new campus today!
MESSAGES
12m ago
Octavia
Meeting got canceled today...
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
112

Figure 5CN

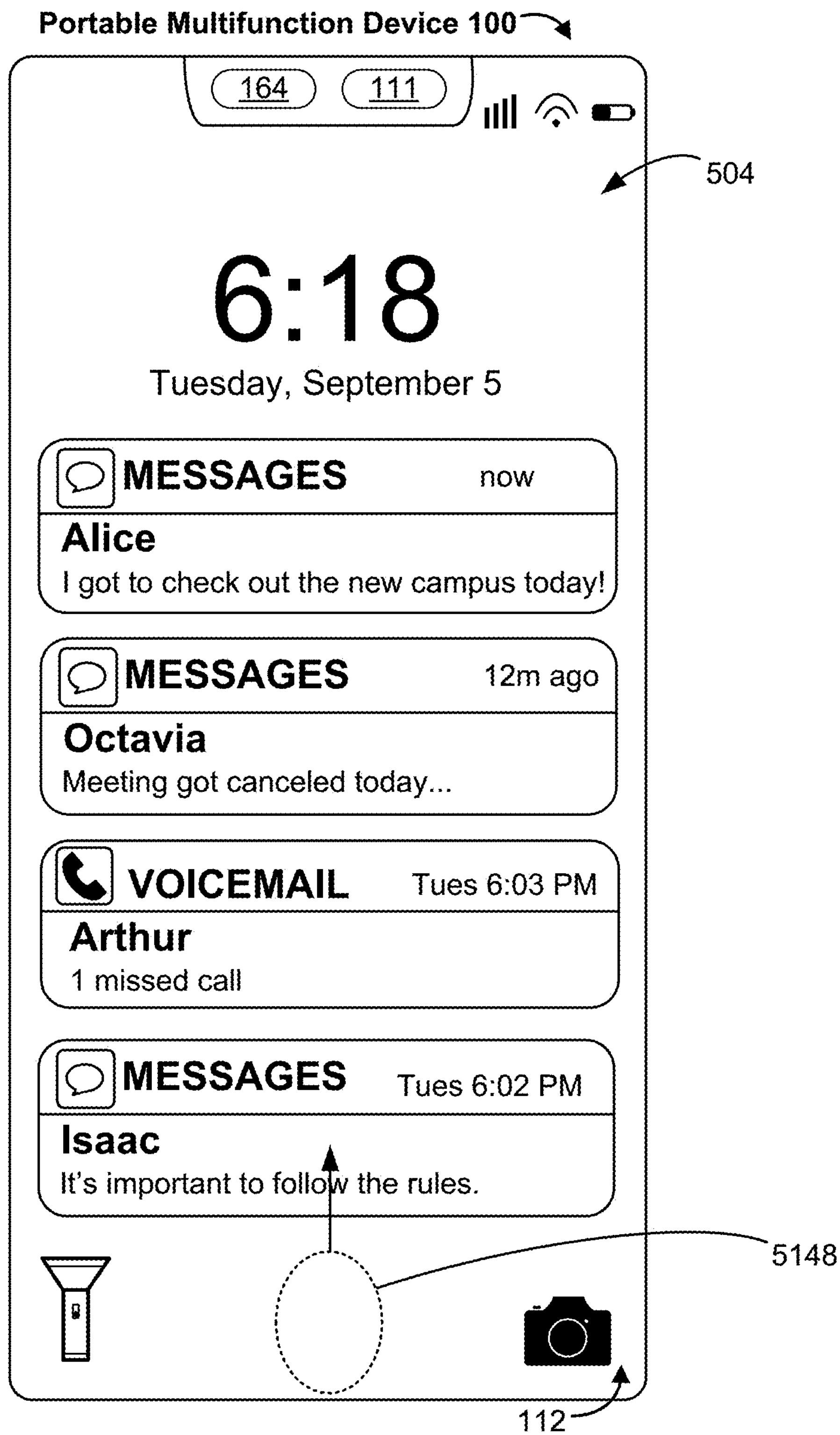

Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
MESSAGES
now
Alice
I got to check out the new campus today!
MESSAGES
12m ago
Octavia
Meeting got canceled today...
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
5148
112

Figure 5CO

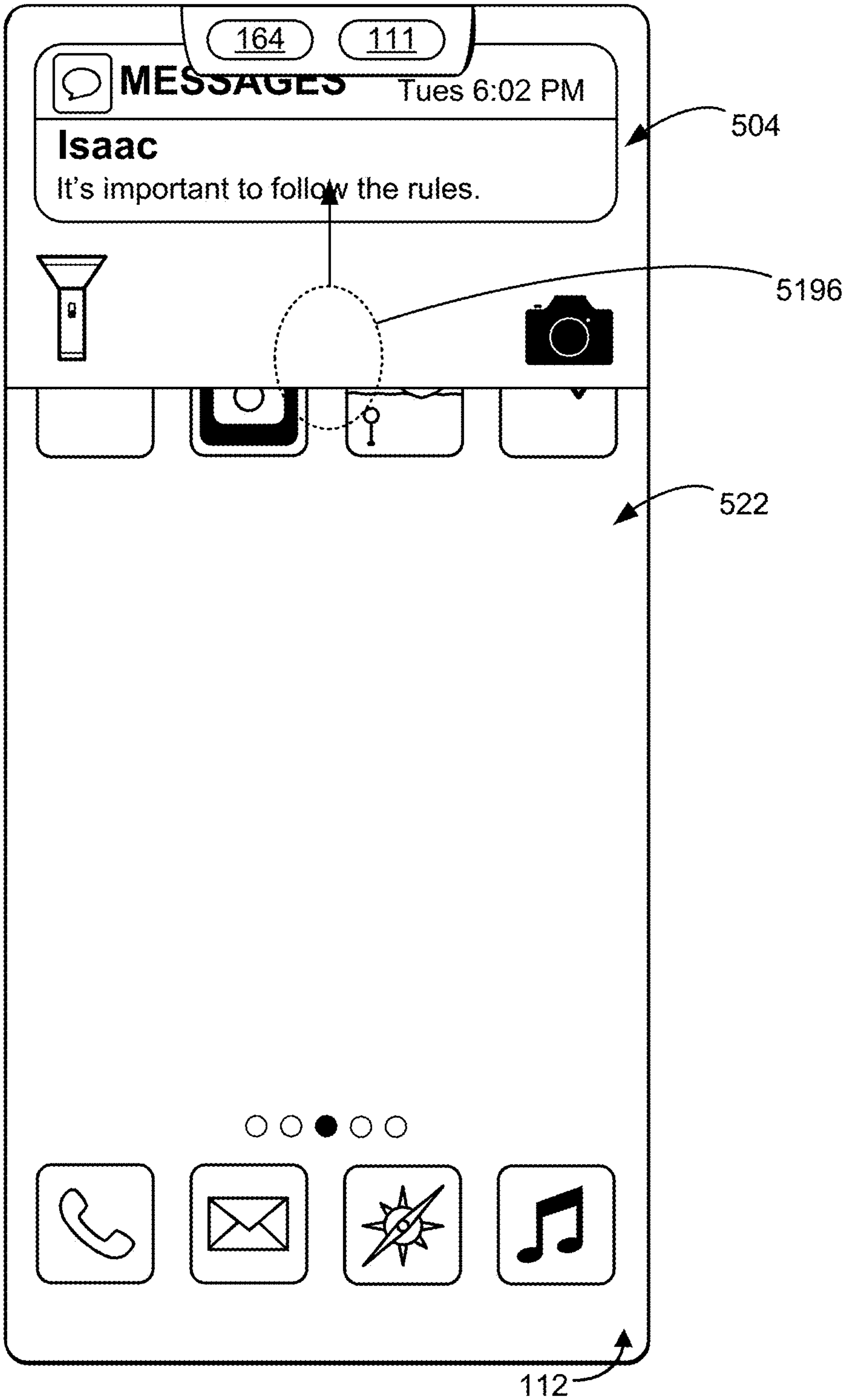
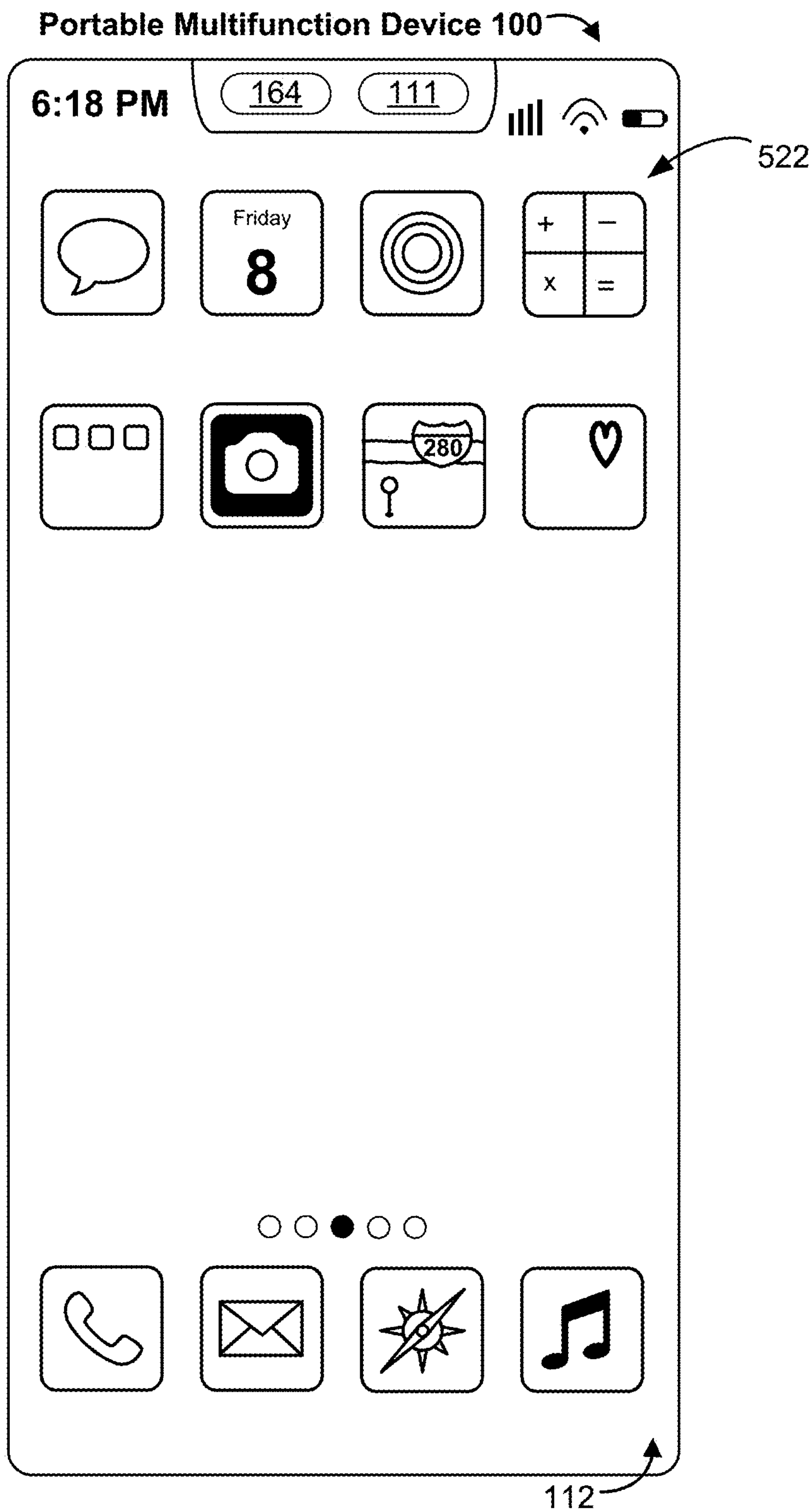

164
111
MESSAGES
Tues 6:02 PM
Isaac
It's important to follow the rules.
504
5196
522
112

Figure 5CP



Portable Multifunction Device 100
6:18 PM
164
111
522
Friday
8
+
−
x
=
280
112

Figure 5CQ

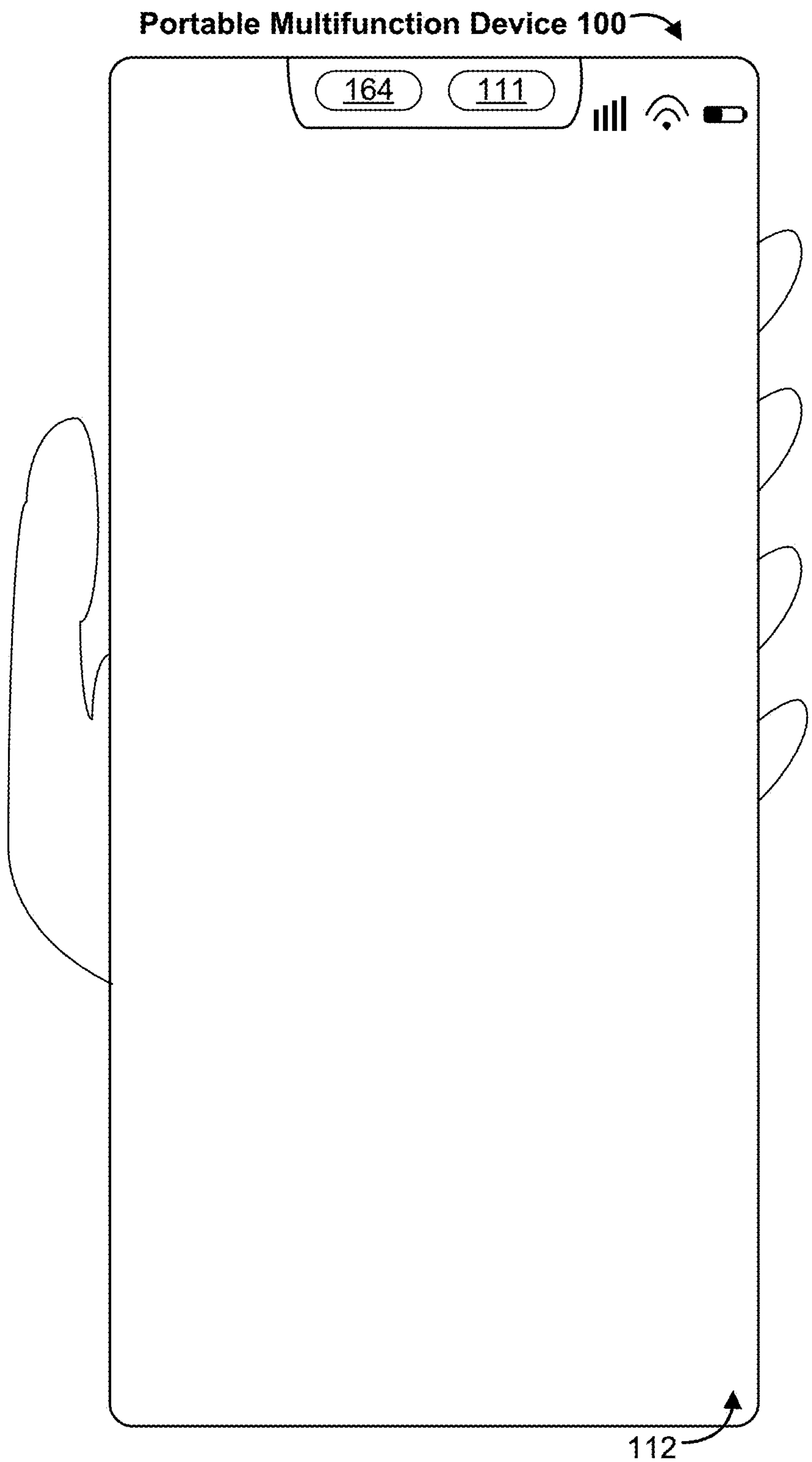


Figure 5CR

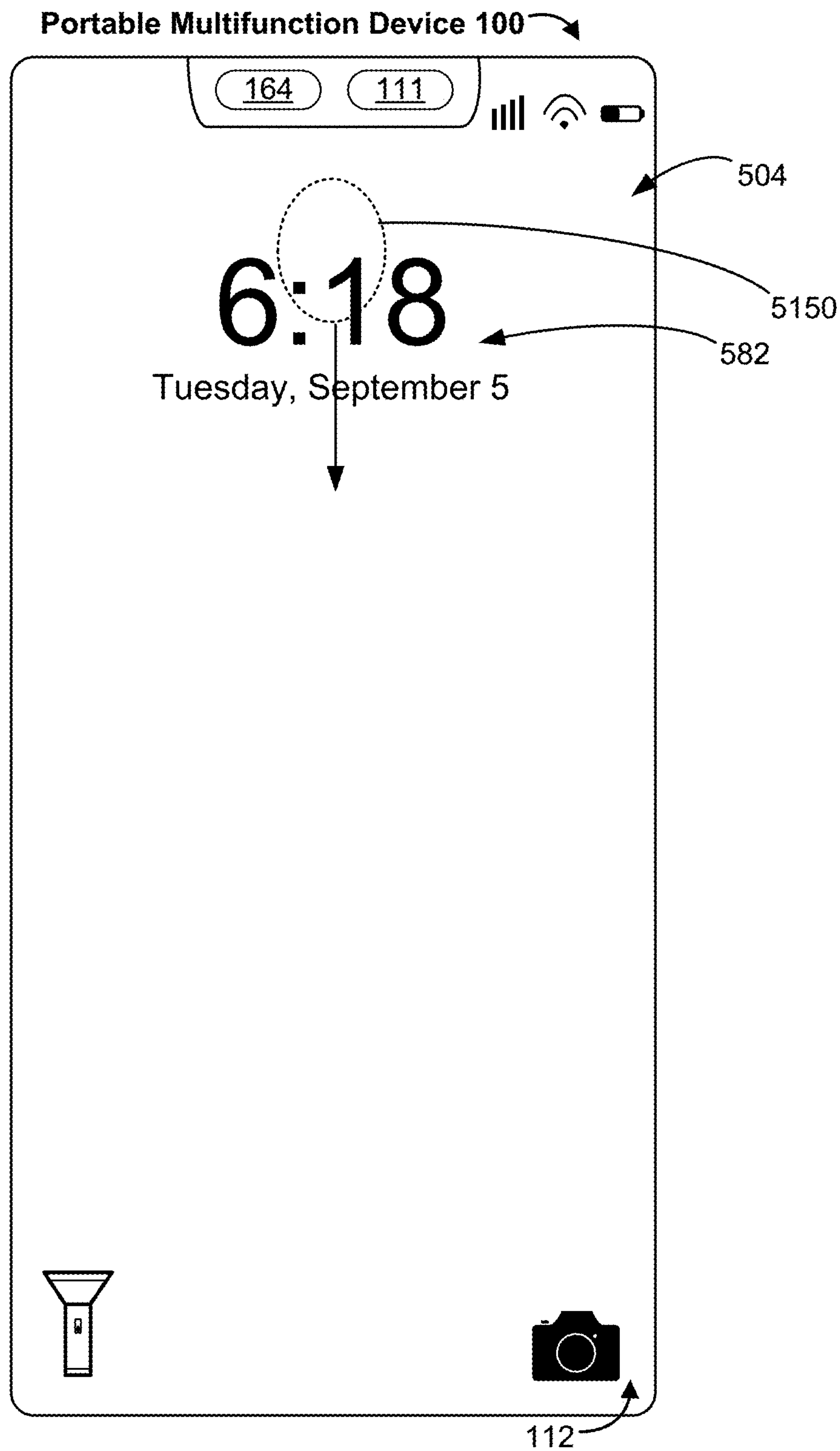

Portable Multifunction Device 100
164
111
504
5150
6:18
582
Tuesday, September 5
112

Figure 5CS

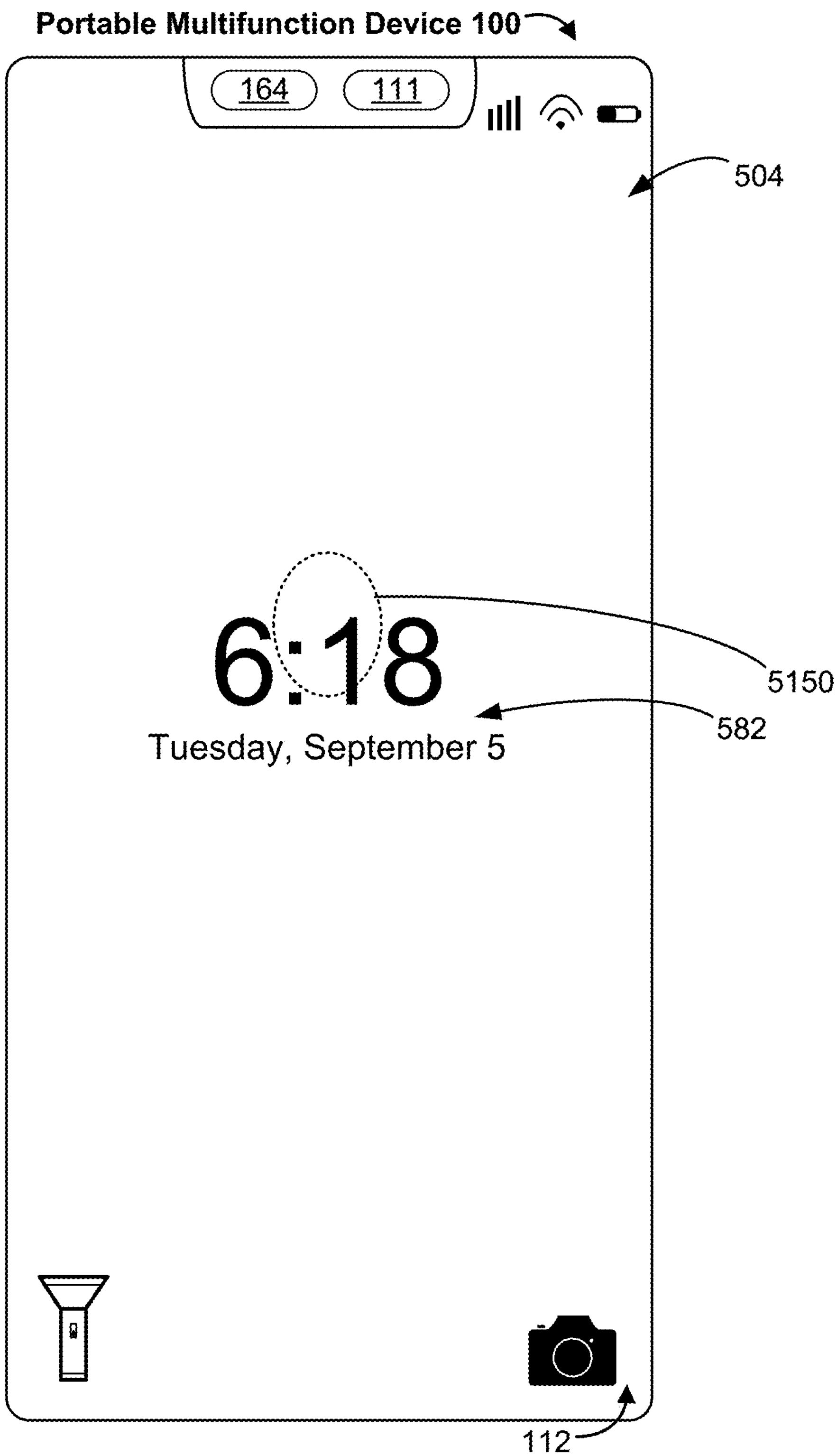

Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
5150
582
112

Figure 5CT

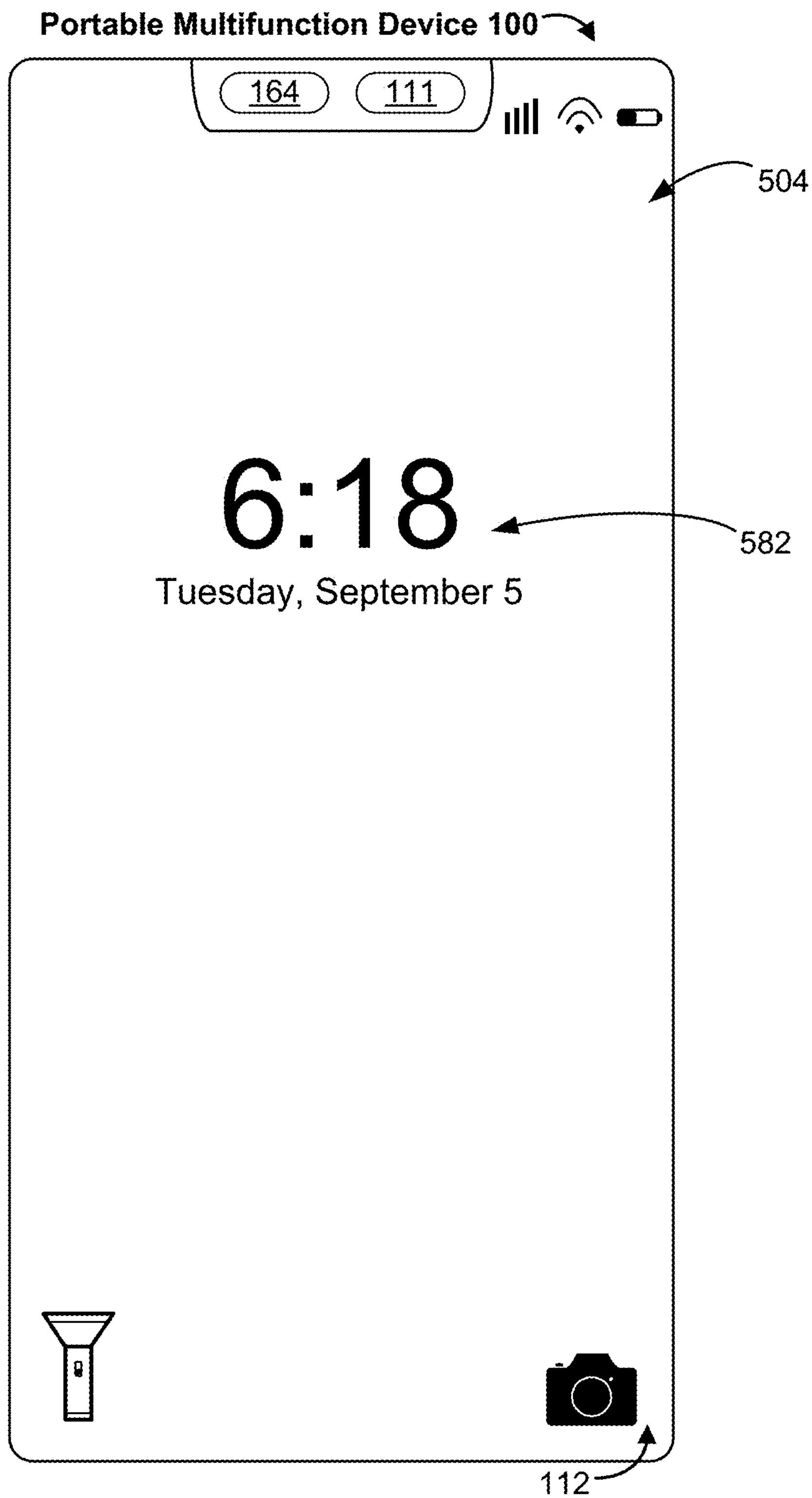
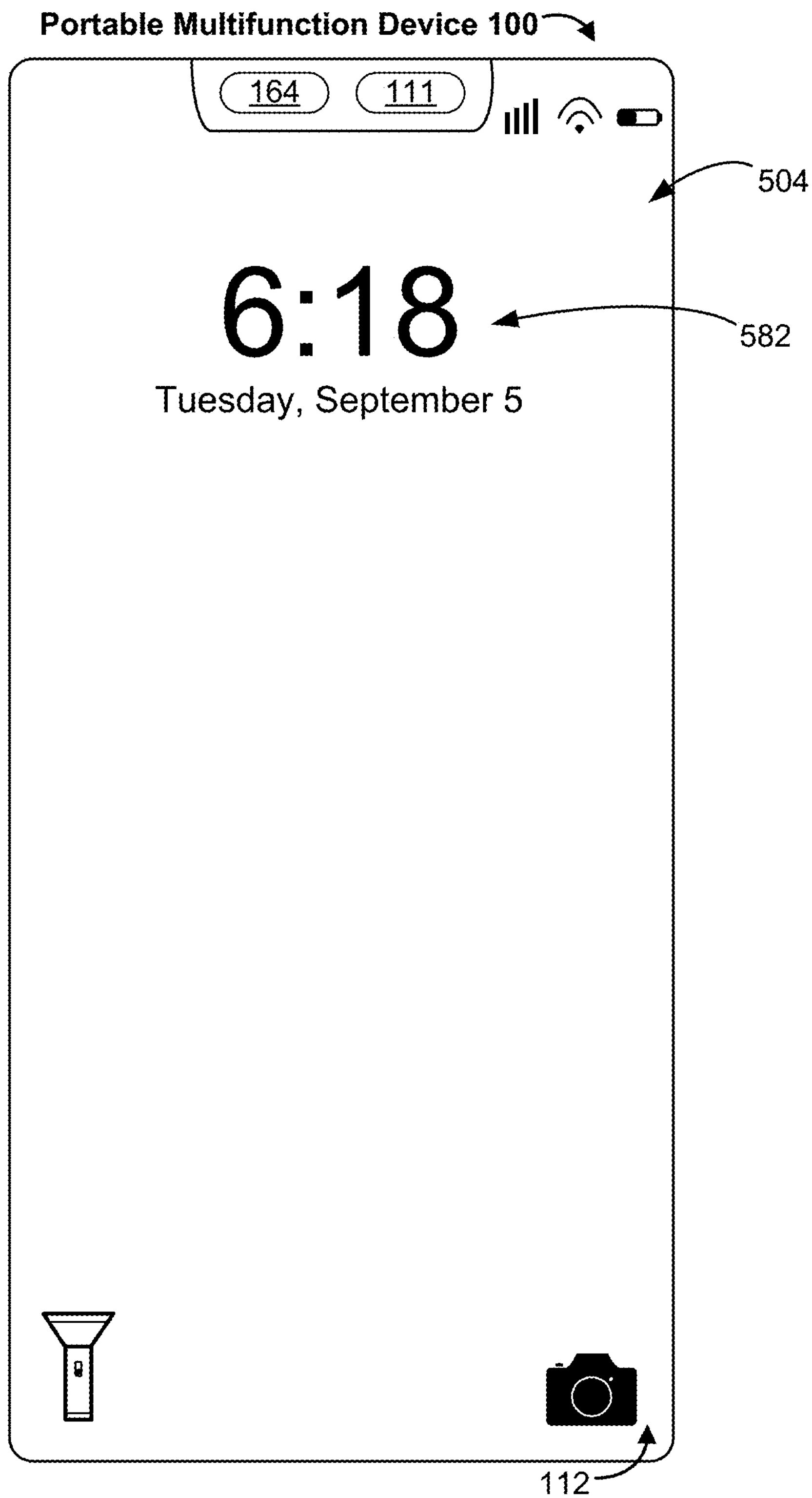
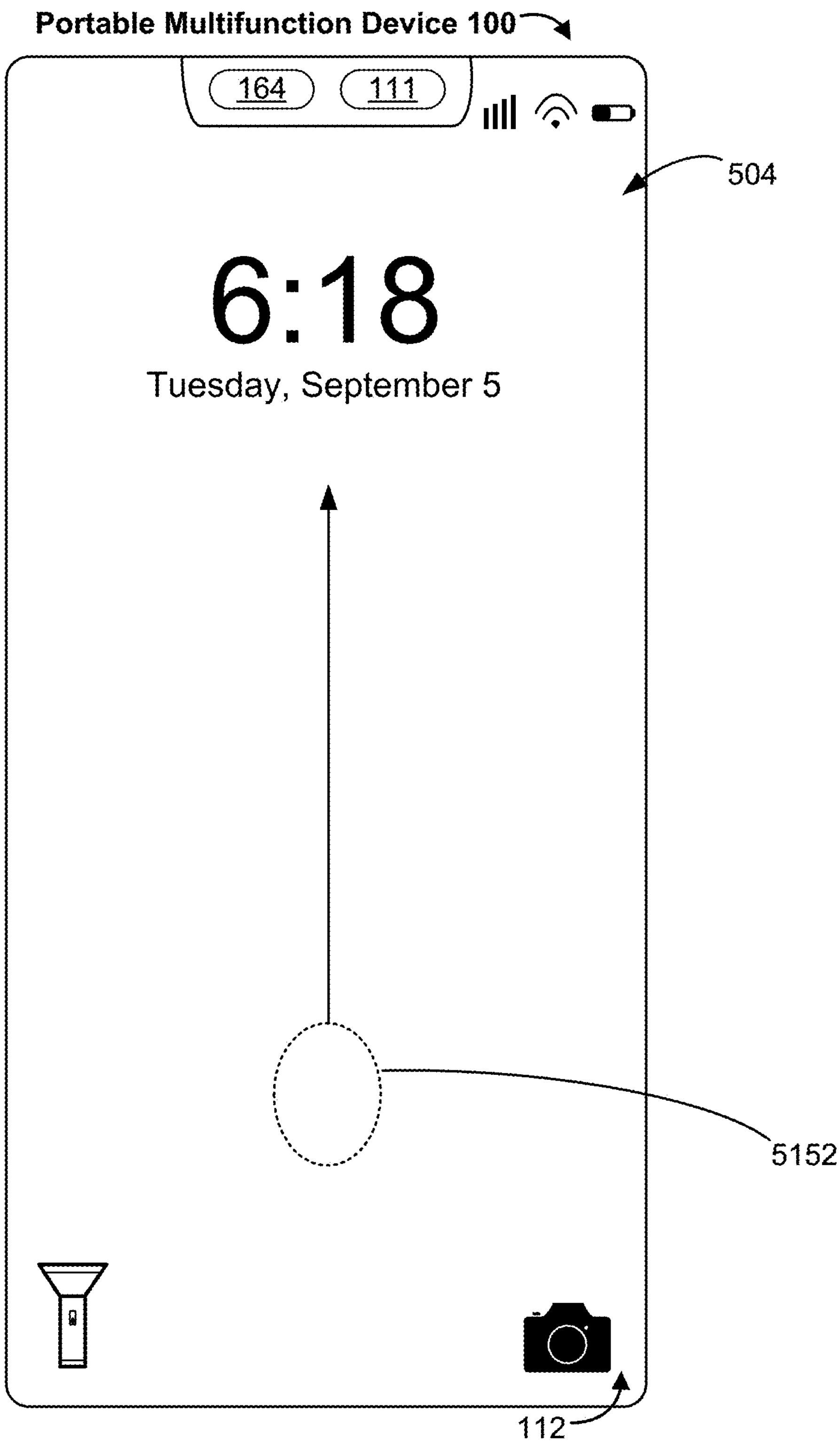

Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
582
112

Figure 5CU



Portable Multifunction Device 100
164
111
504
6:18
582
Tuesday, September 5
112

Figure 5CV



Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
5152
112

Figure 5CW

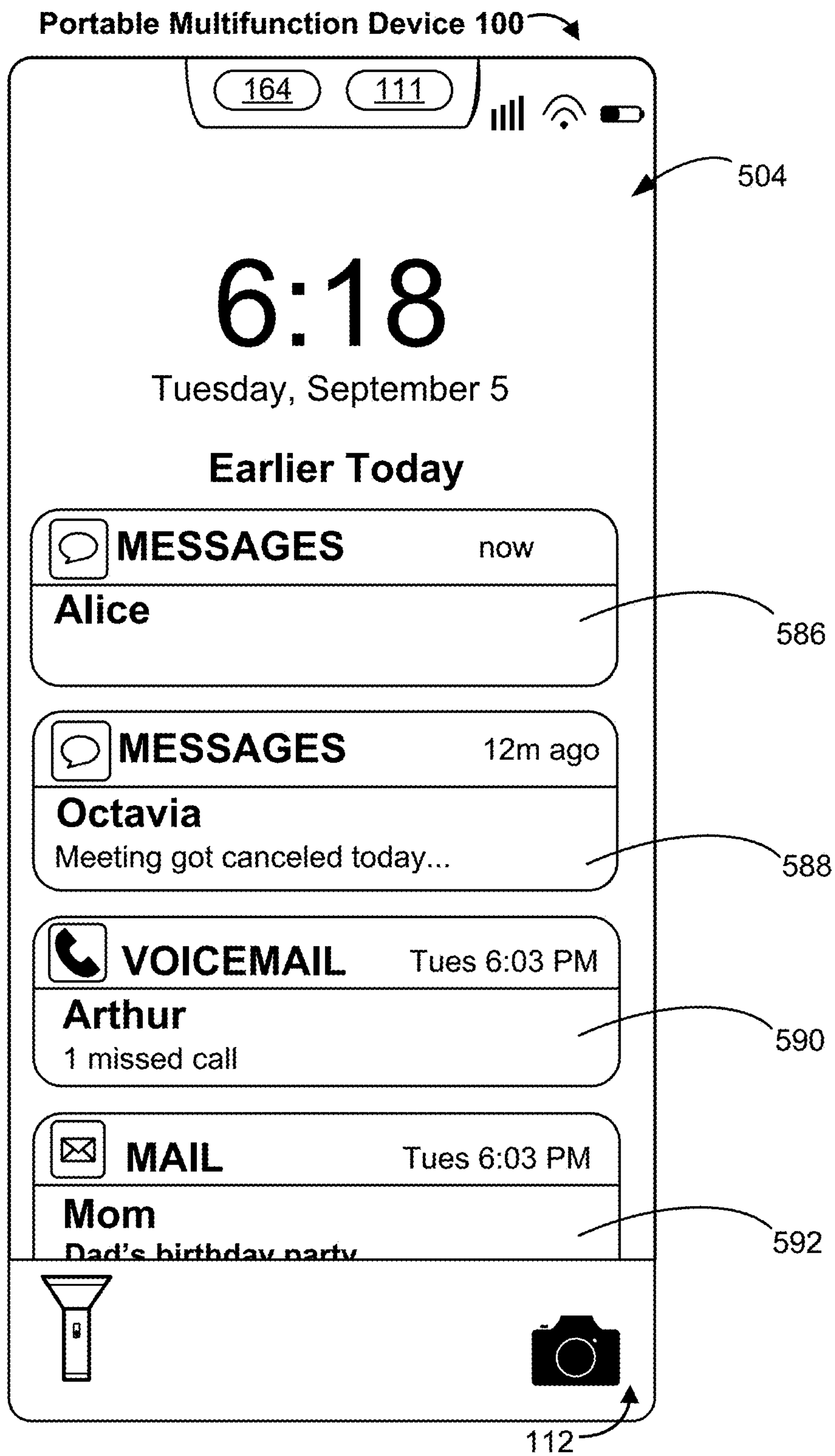

Portable Multifunction Device 100
164
111
504
6:18
Tuesday, September 5
Earlier Today
MESSAGES
now
Alice
586
MESSAGES
12m ago
Octavia
Meeting got canceled today...
588
VOICEMAIL
Tues 6:03 PM
Arthur
1 missed call
590
MAIL
Tues 6:03 PM
Mom
592
112

Figure 5CX

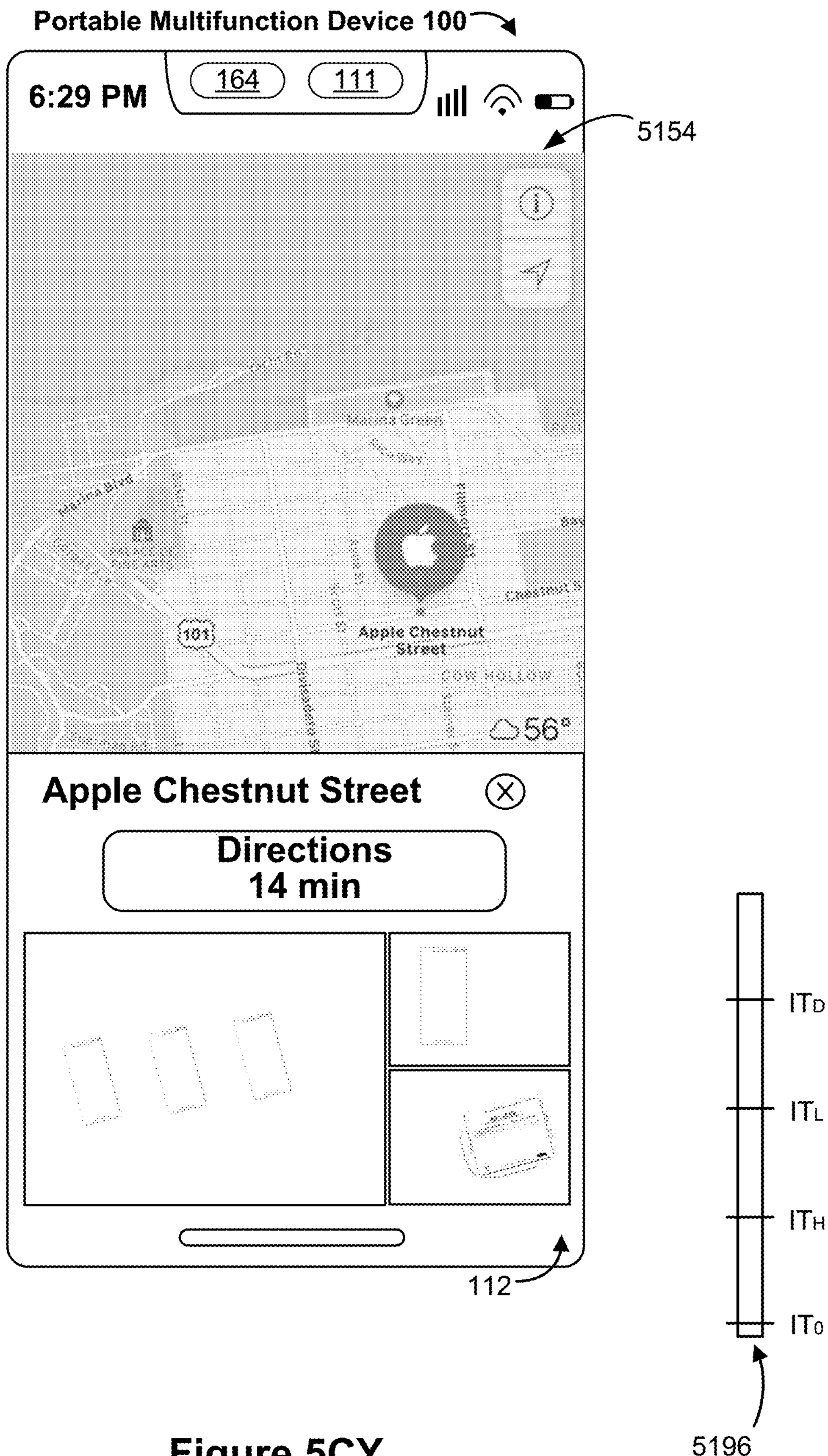
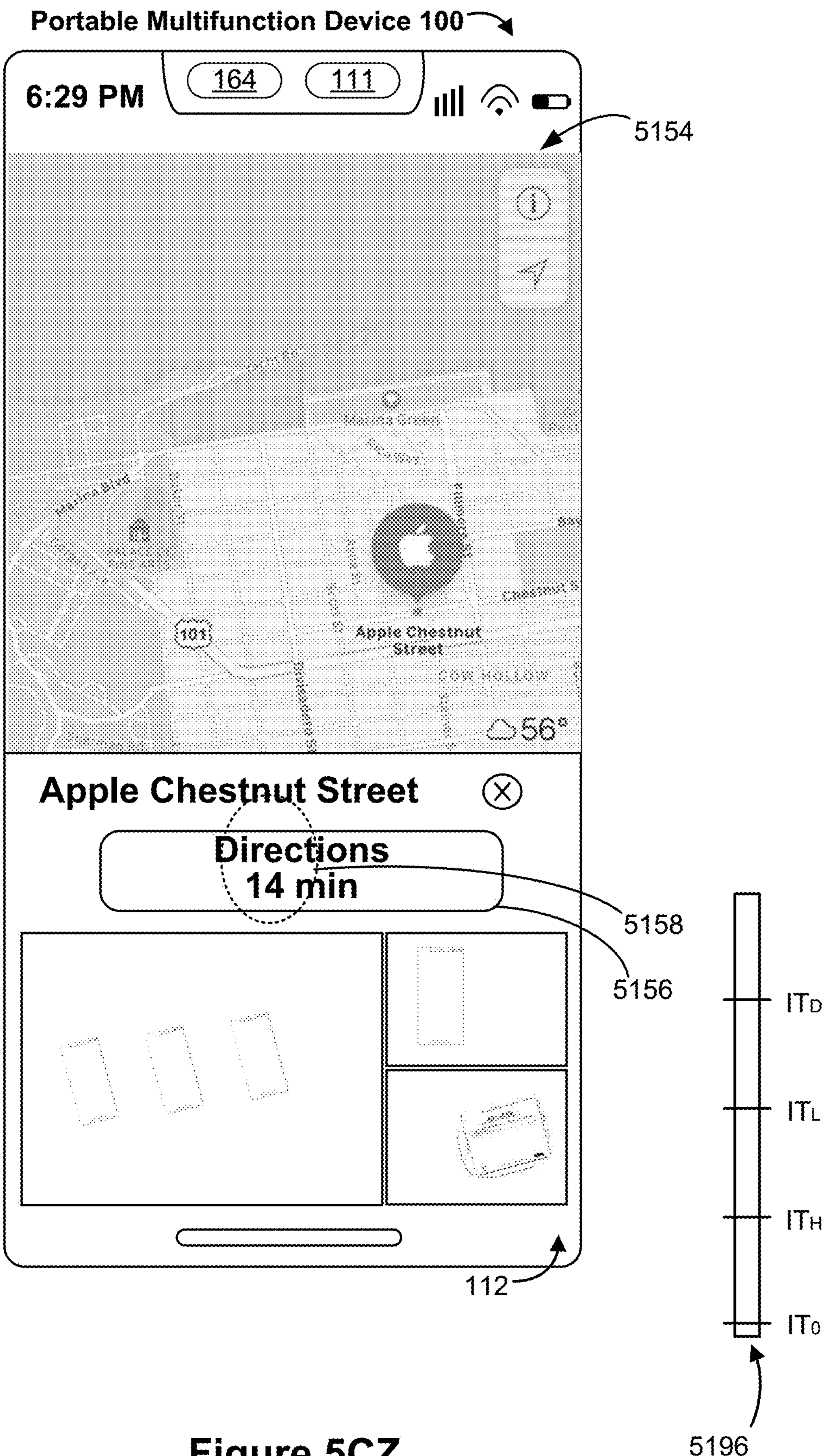

Portable Multifunction Device 100
6:29 PM
164
111
5154
Apple Chestnut Street
101
COW HOLLOW
56°
Apple Chestnut Street
Directions
14 min
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5CY



Portable Multifunction Device 100
6:29 PM
164
111
5154
Apple Chestnut Street
56°
Apple Chestnut Street
Directions
14 min
5158
5156
112
ITD
ITL
ITH
IT0
5196

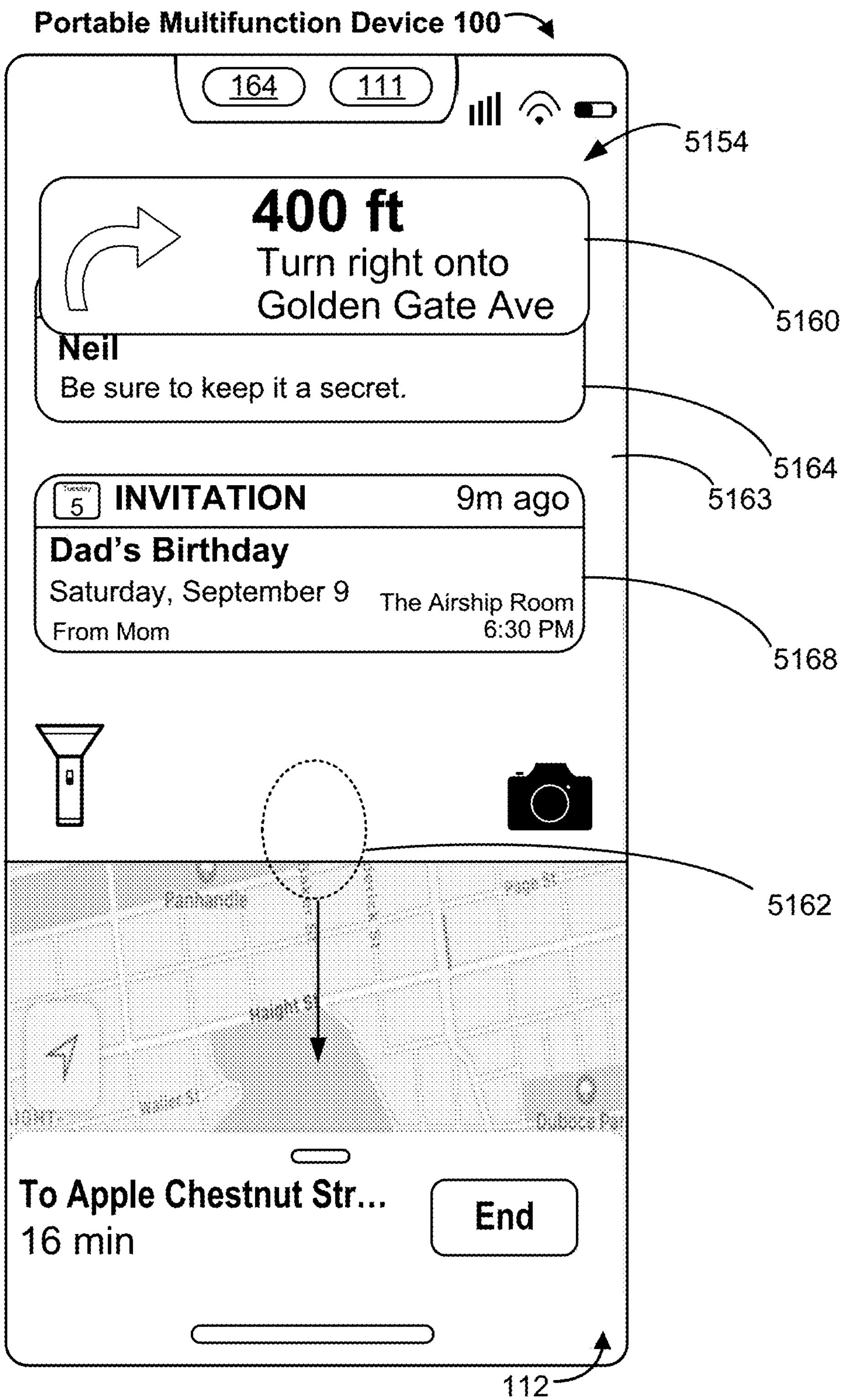
Figure 5CZ


Portable Multifunction Device 100
6:29 PM
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
5160
Turk St
Golden Gate Ave
Fulton St
Alamo Square
Grove St
Fell St
Panhandle
Page St
Haight St
Waller St
To Apple Chestnut Str...
16 min
End
112

Figure 5DA


Portable Multifunction Device 100
6:29 PM
164
111
400 ft
Turn right onto
Golden Gate Ave
5162
5160
Turk St
Golden Gate Ave
Fulton St
Alamo Square
Grove St
Fell St
Panhandle
Page St
Haight St
To Apple Chestnut Str...
16 min
End
112

Figure 5DB



Portable Multifunction Device 100
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
5160
Neil
Be sure to keep it a secret.
5164
5163
5
INVITATION
9m ago
Dad's Birthday
Saturday, September 9
The Airship Room
From Mom
6:30 PM
5168
5162
To Apple Chestnut Str...
16 min
End
112

Figure 5DC

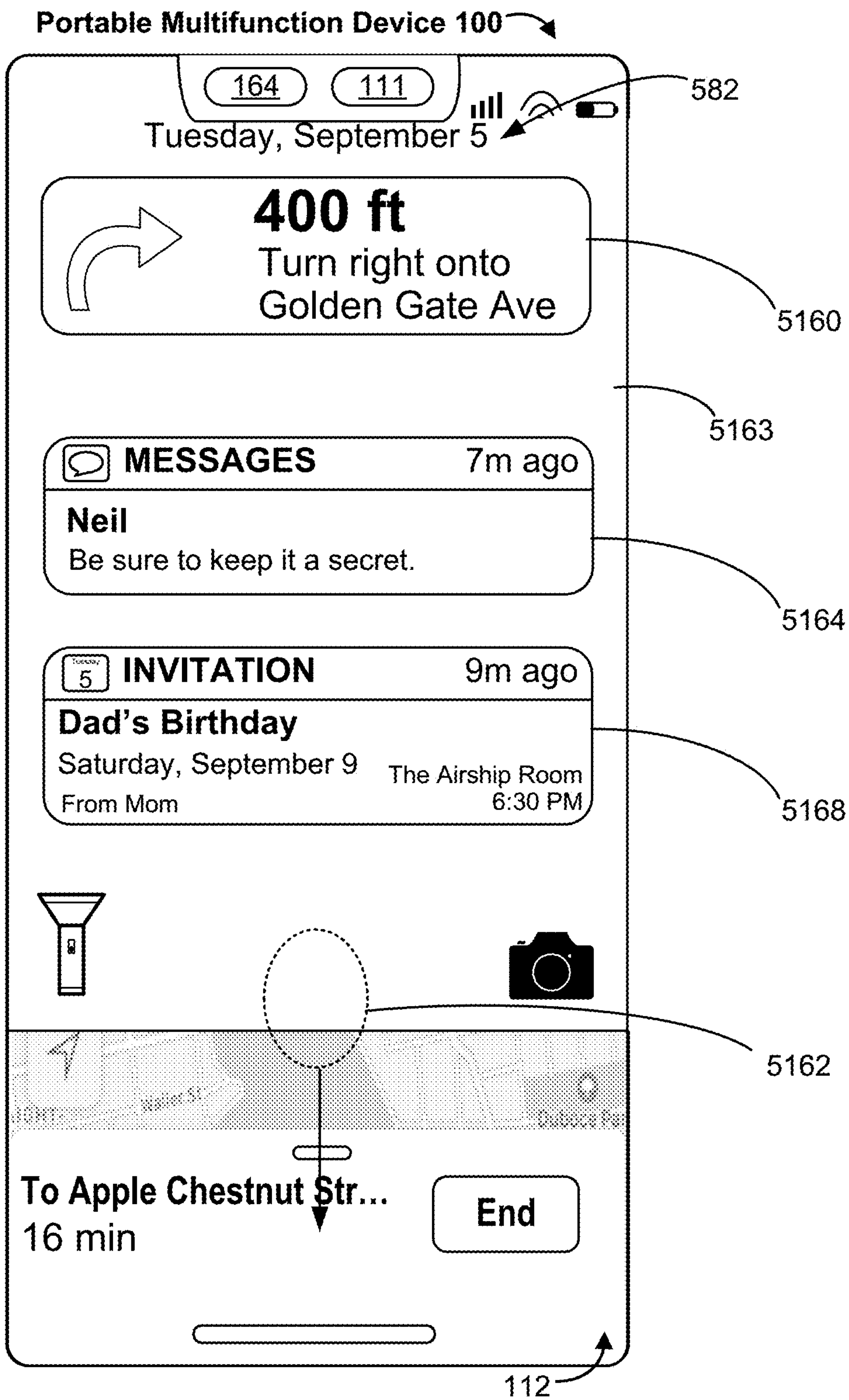

Portable Multifunction Device 100
164
111
582
Tuesday, September 5
400 ft
Turn right onto
Golden Gate Ave
5160
5163
MESSAGES
7m ago
Neil
Be sure to keep it a secret.
5164
INVITATION
9m ago
5
Dad's Birthday
Saturday, September 9
The Airship Room
From Mom
6:30 PM
5168
5162
To Apple Chestnut Str...
16 min
End
112

Figure 5DD


Portable Multifunction Device 100
164
111
5154
6:29
Tuesday, September 5
582
5163
400 ft
Turn right onto
Golden Gate Ave
5160
MESSAGES
7m ago
Neil
Be sure to keep it a secret.
5164
INVITATION
9m ago
5
Dad's Birthday
Saturday, September 9
The Airship Room
6:30 PM
From Mom
5168
16 min
5162
112

Figure 5DE

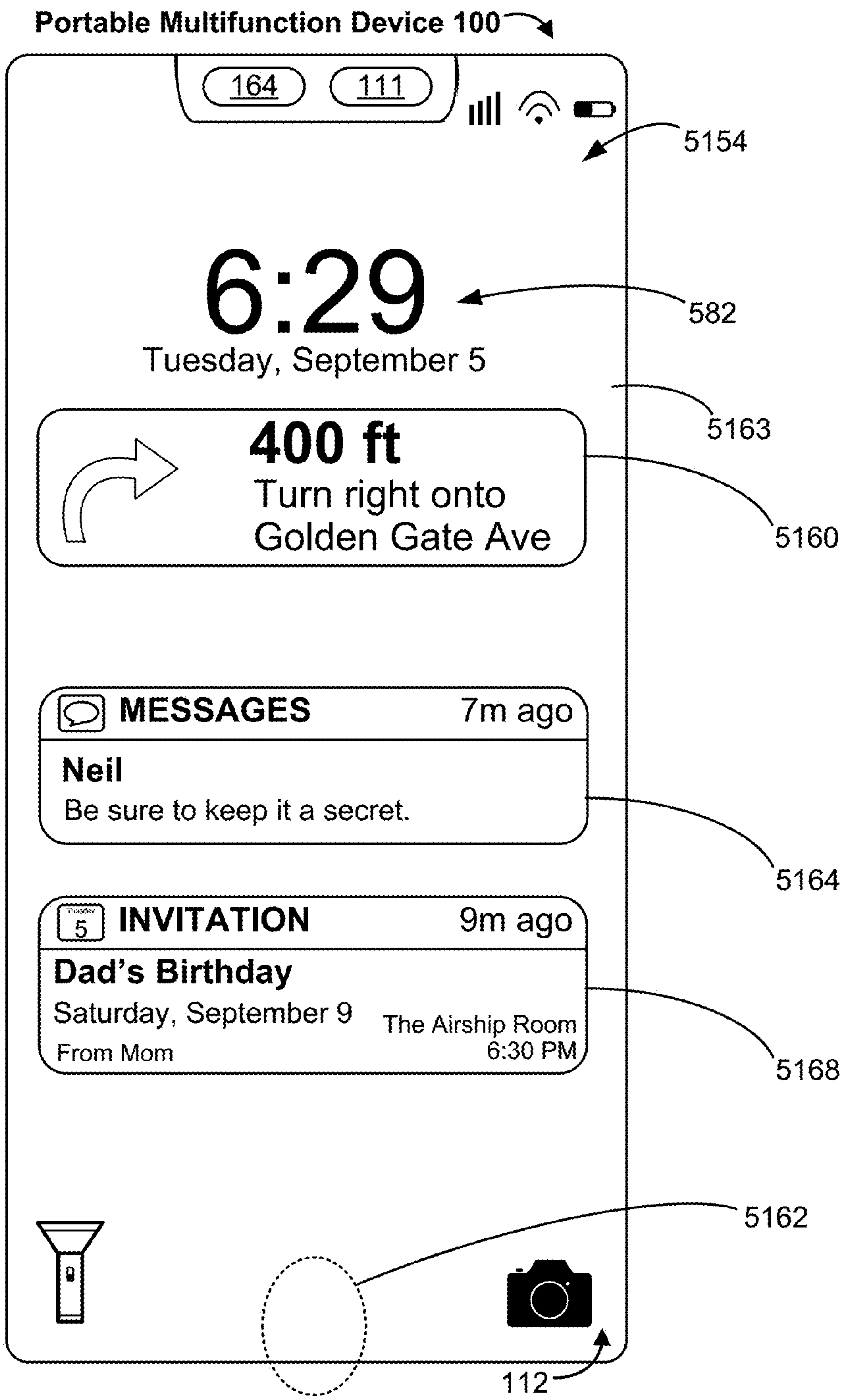

Portable Multifunction Device 100
164
111
5154
6:29
Tuesday, September 5
582
5163
400 ft
Turn right onto
Golden Gate Ave
5160
MESSAGES
7m ago
Neil
Be sure to keep it a secret.
5164
INVITATION
9m ago
5
Dad's Birthday
Saturday, September 9
The Airship Room
From Mom
6:30 PM
5168
5162
112

Figure 5DF

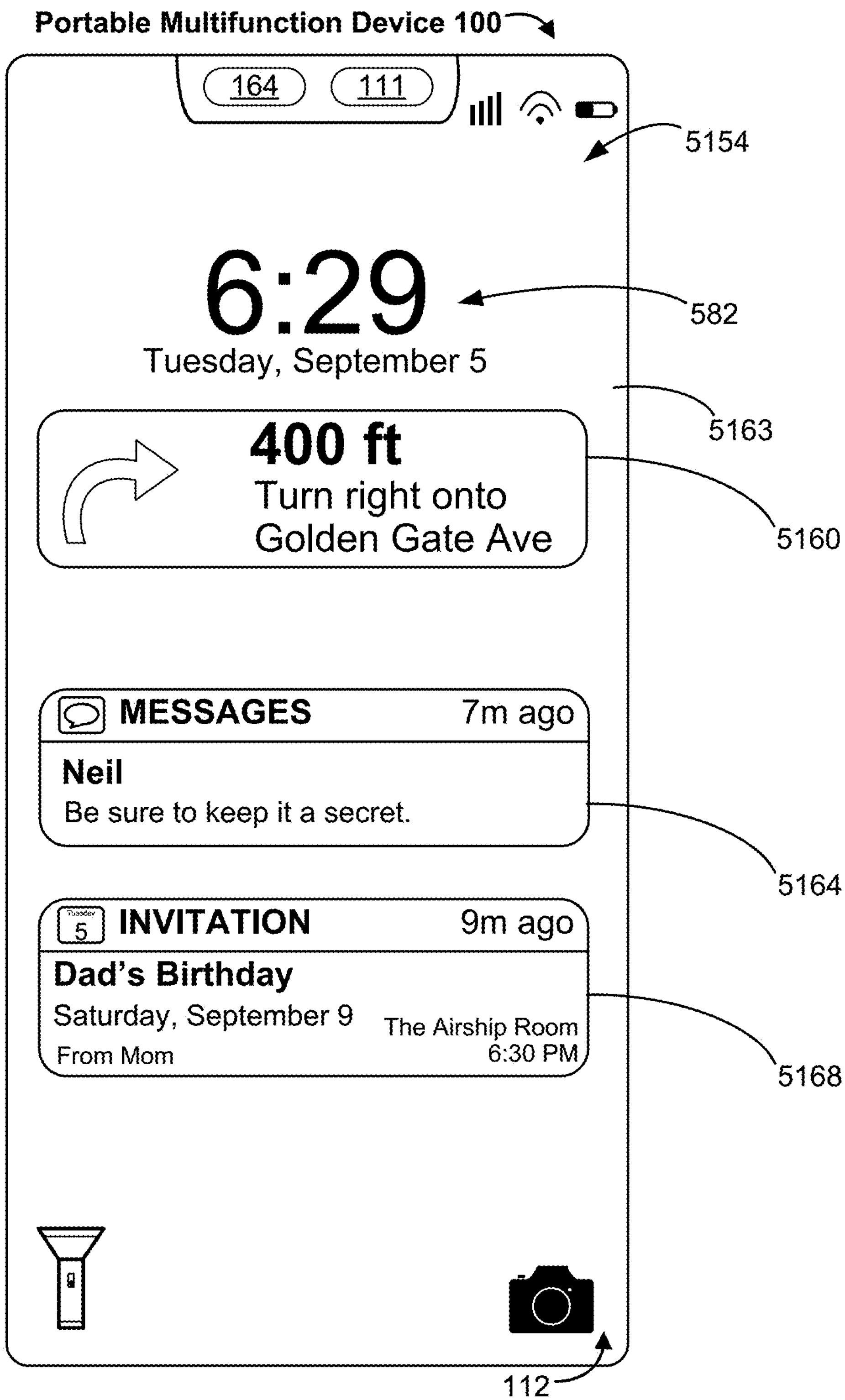
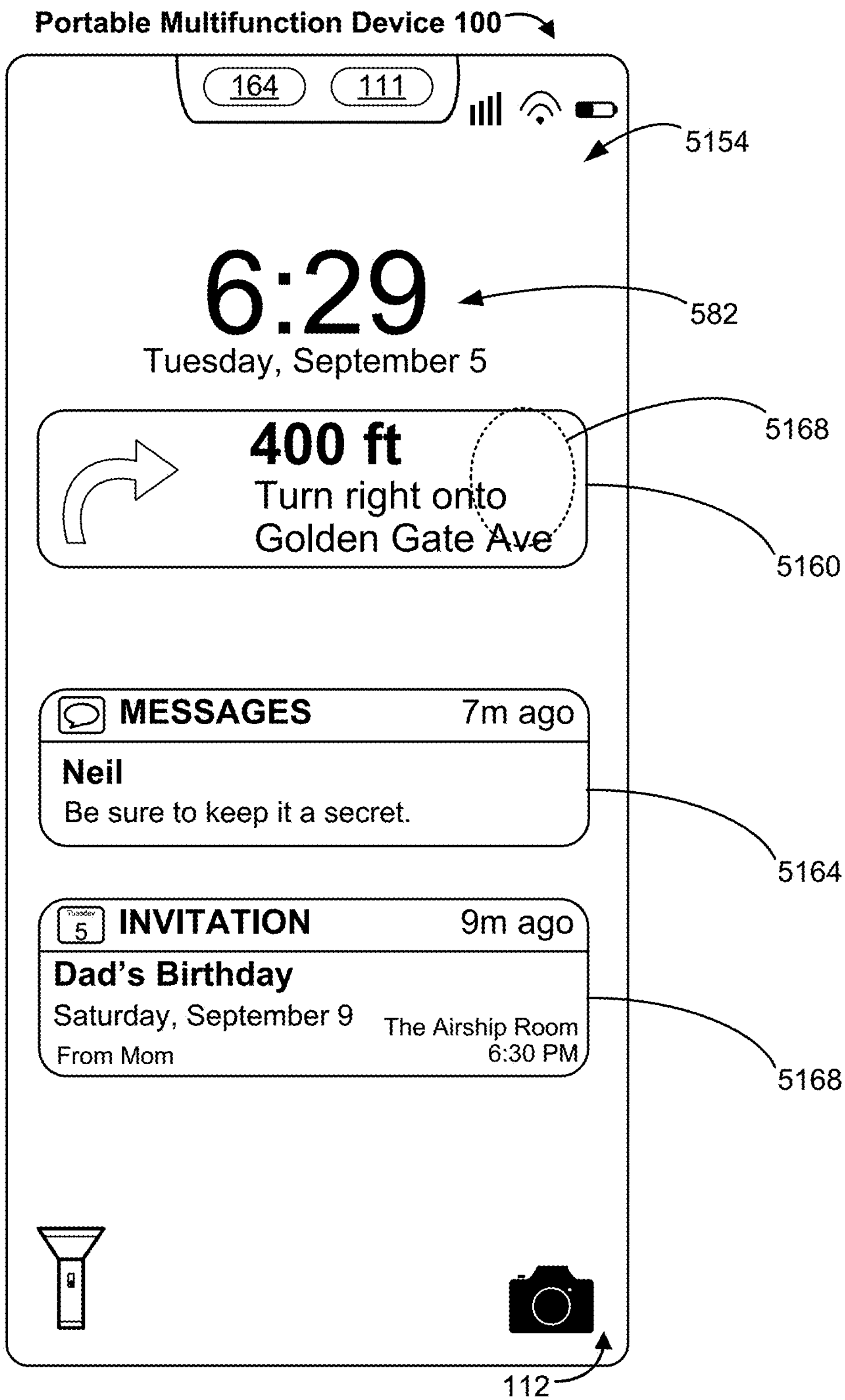

Portable Multifunction Device 100
164
111
5154
6:29
Tuesday, September 5
582
5163
400 ft
Turn right onto
Golden Gate Ave
5160
MESSAGES
7m ago
Neil
Be sure to keep it a secret.
5164
5
INVITATION
9m ago
Dad's Birthday
Saturday, September 9
The Airship Room
6:30 PM
From Mom
5168
112

Figure 5DG

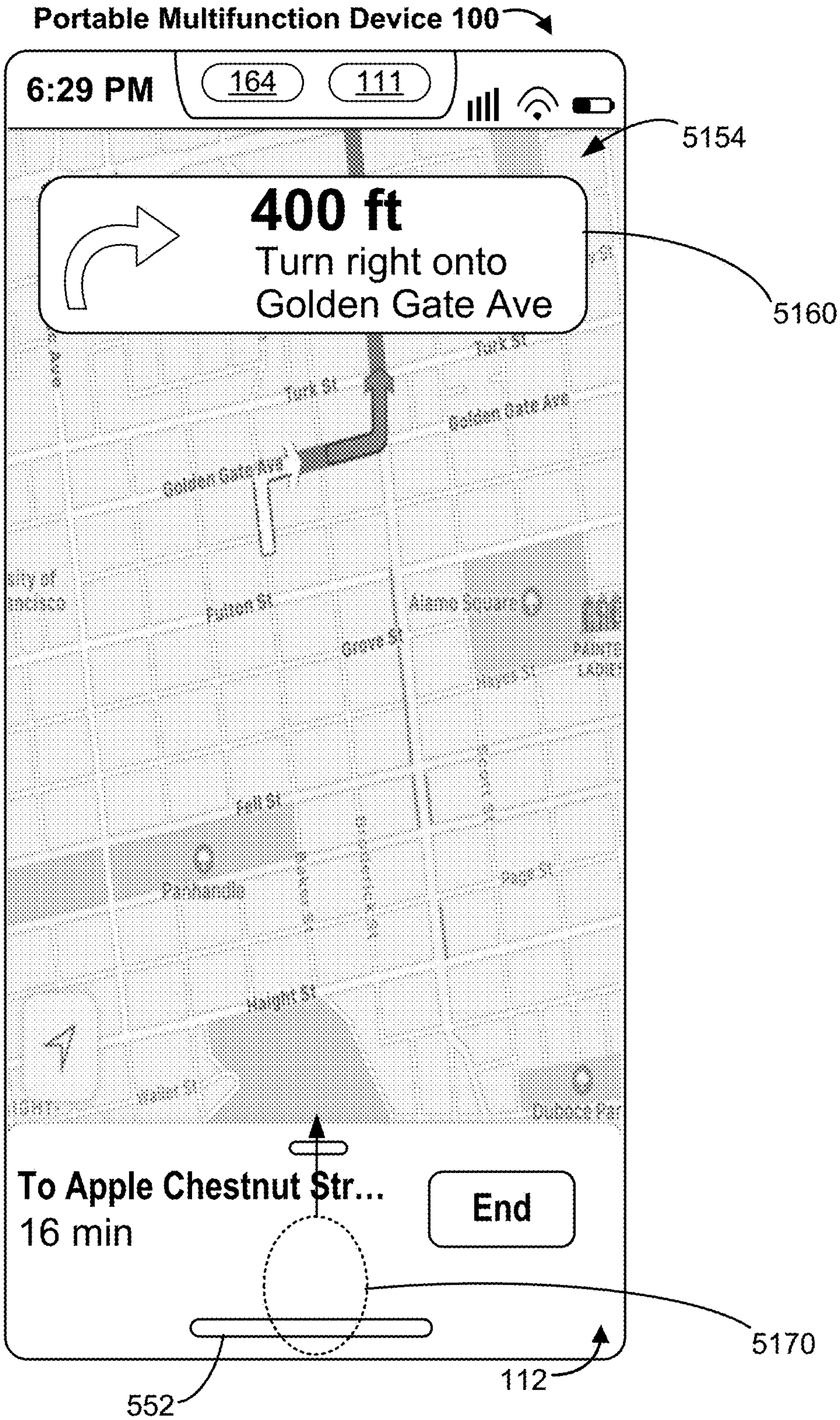


Portable Multifunction Device 100
164
111
5154
6:29
582
Tuesday, September 5
400 ft
Turn right onto
Golden Gate Ave
5168
5160
MESSAGES
7m ago
Neil
Be sure to keep it a secret.
5164
INVITATION
9m ago
5
Dad's Birthday
Saturday, September 9
From Mom
The Airship Room
6:30 PM
5168
112

Figure 5DH

Portable Multifunction Device 100
6:29 PM
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
5160
Turk St
Golden Gate Ave
Fulton St
Alamo Square
Grove St
Fell St
Panhandle
Page St
Haight St
To Apple Chestnut Str...
16 min
End
112

Figure 5DI



Portable Multifunction Device 100
6:29 PM
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
5160
Turk St
Golden Gate Ave
Fulton St
Alamo Square
Grove St
Fell St
Panhandle
Page St
Haight St
To Apple Chestnut Str...
16 min
End
5170
552
112

Figure 5DJ

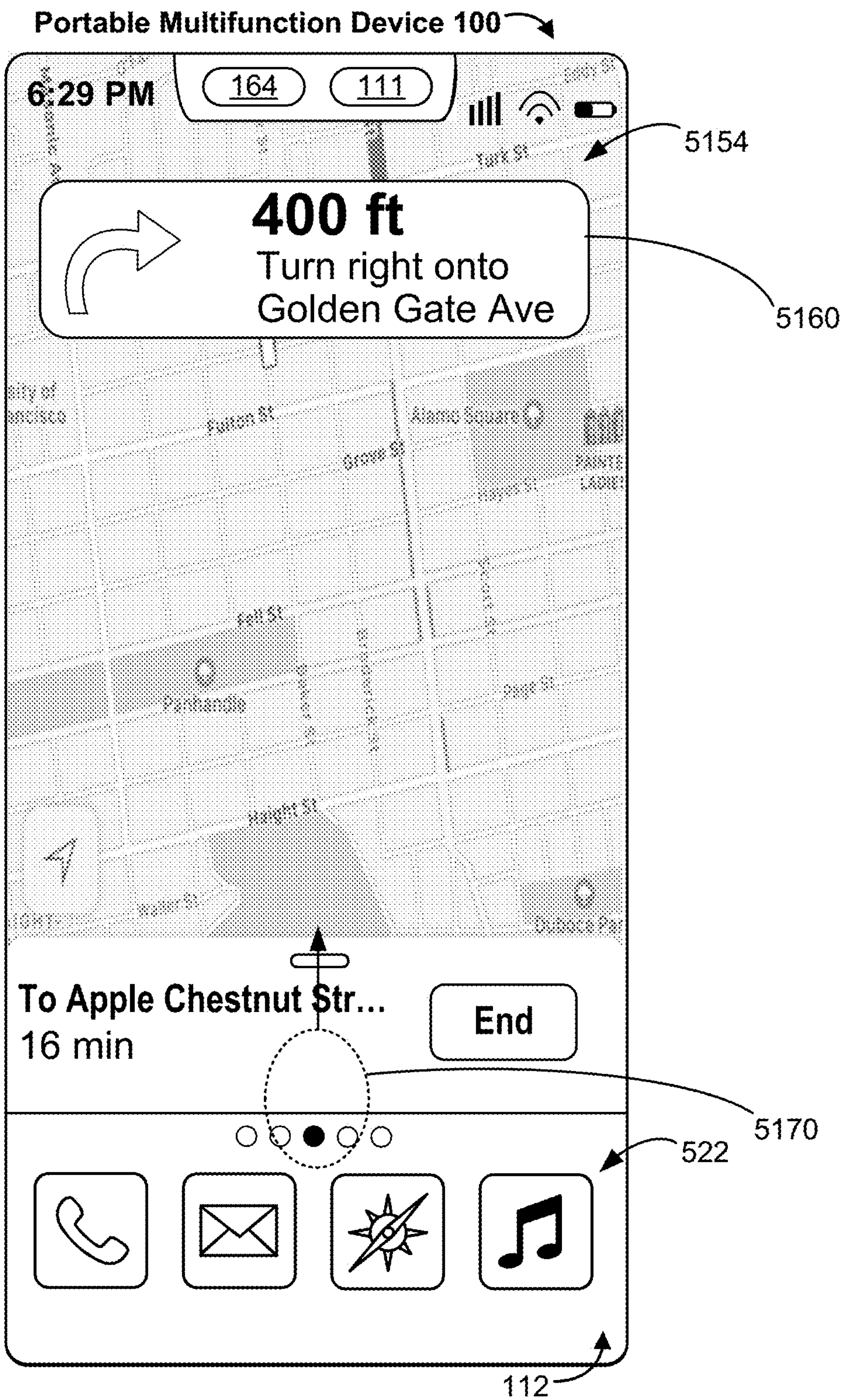
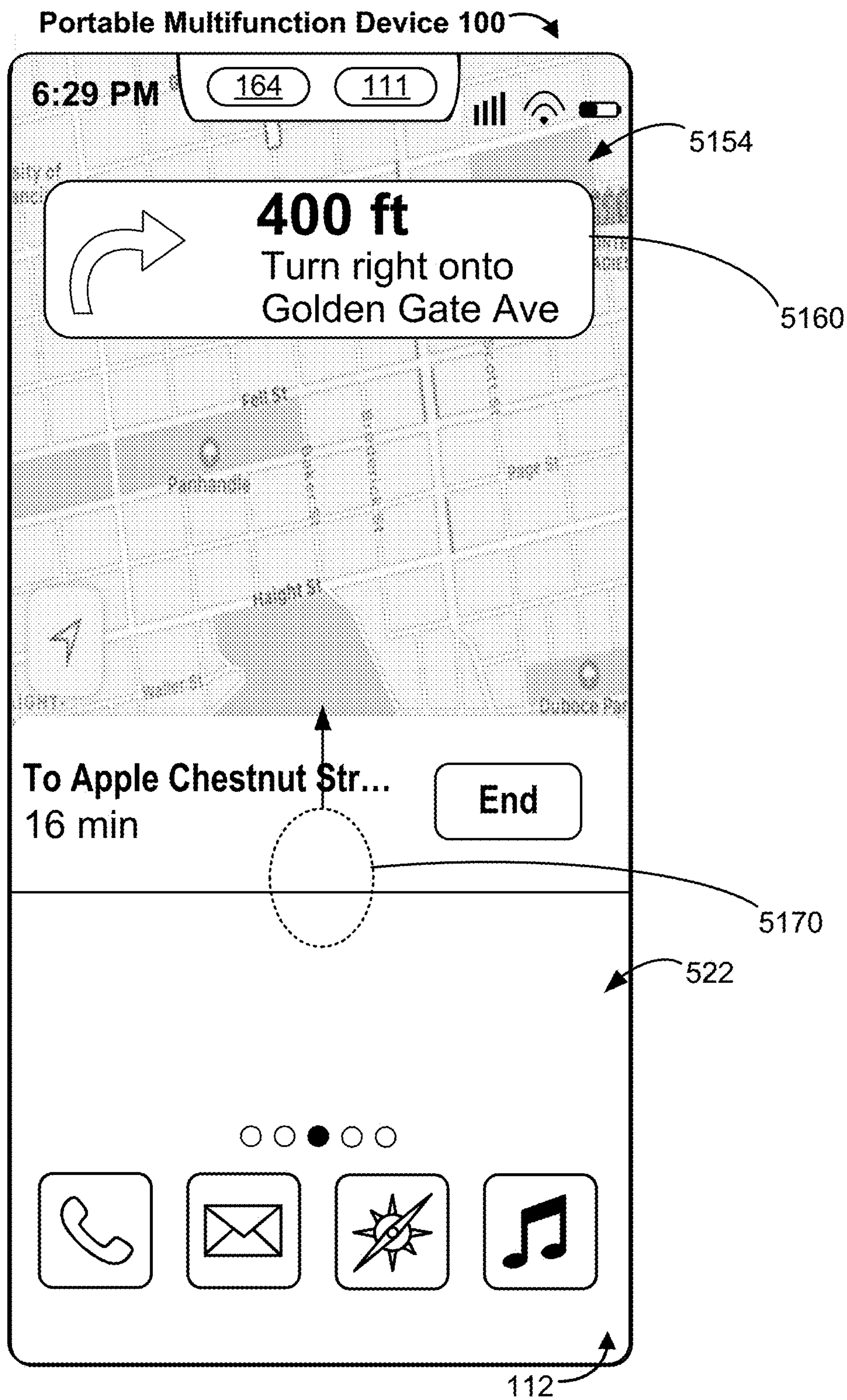
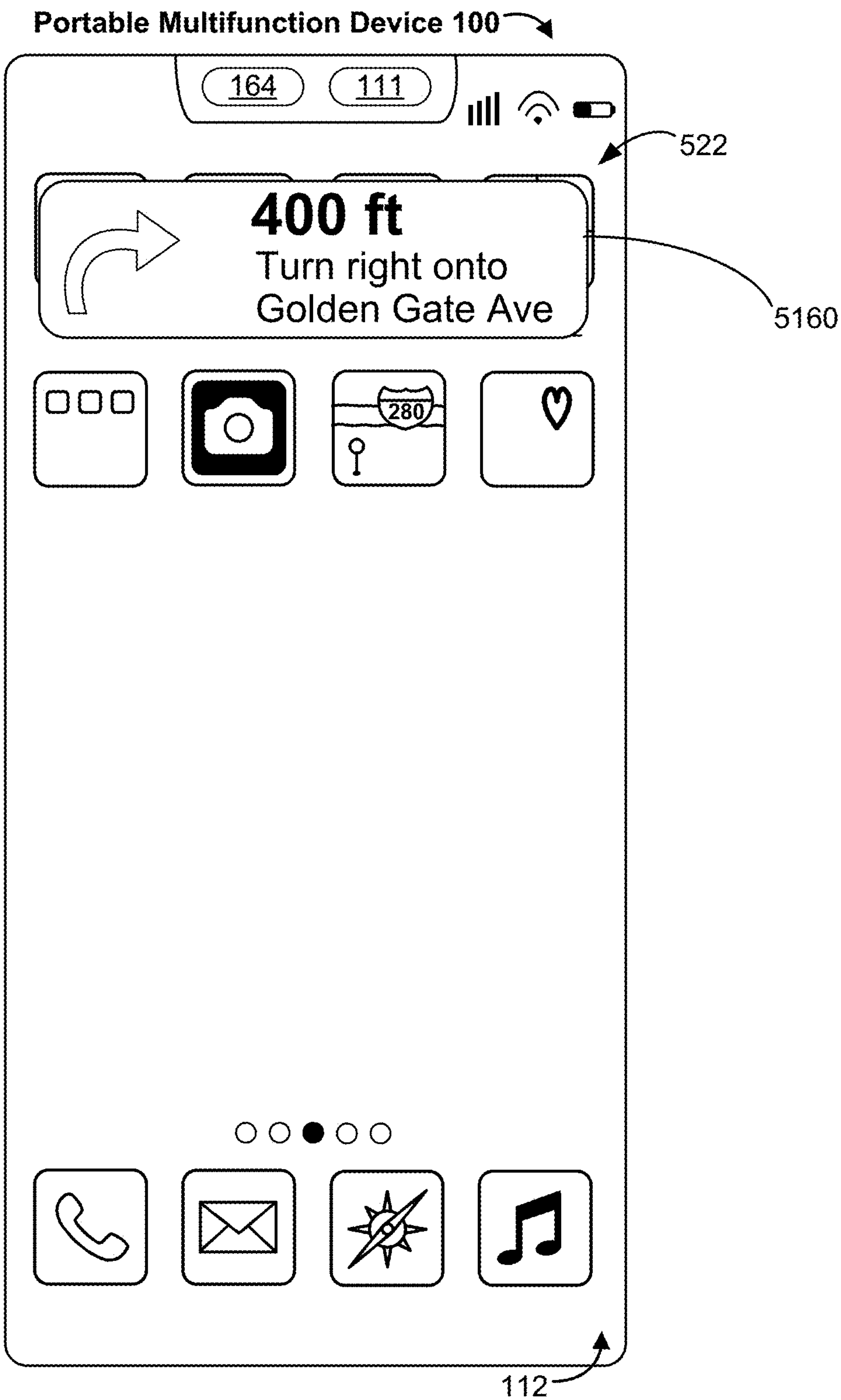

Portable Multifunction Device 100
6:29 PM
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
5160
Fulton St
Alamo Square
Grove St
Fell St
Panhandle
Page St
Haight St
To Apple Chestnut Str…
16 min
End
5170
522
112

Figure 5DK



Portable Multifunction Device 100
6:29 PM
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
5160
To Apple Chestnut Str...
16 min
End
5170
522
112

Figure 5DL



Portable Multifunction Device 100
164
111
522
400 ft
Turn right onto
Golden Gate Ave
5160
280
112

Figure 5DM

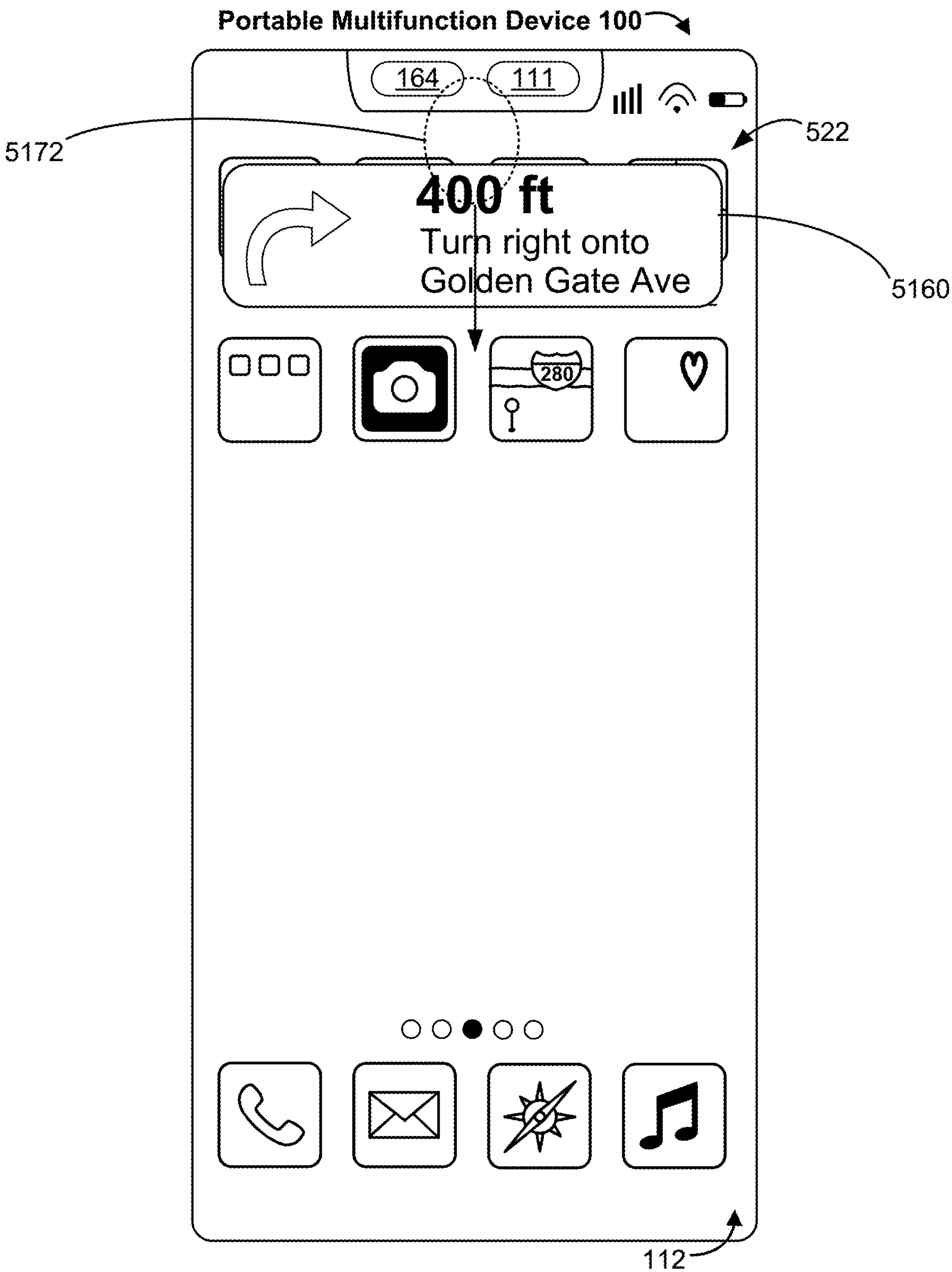
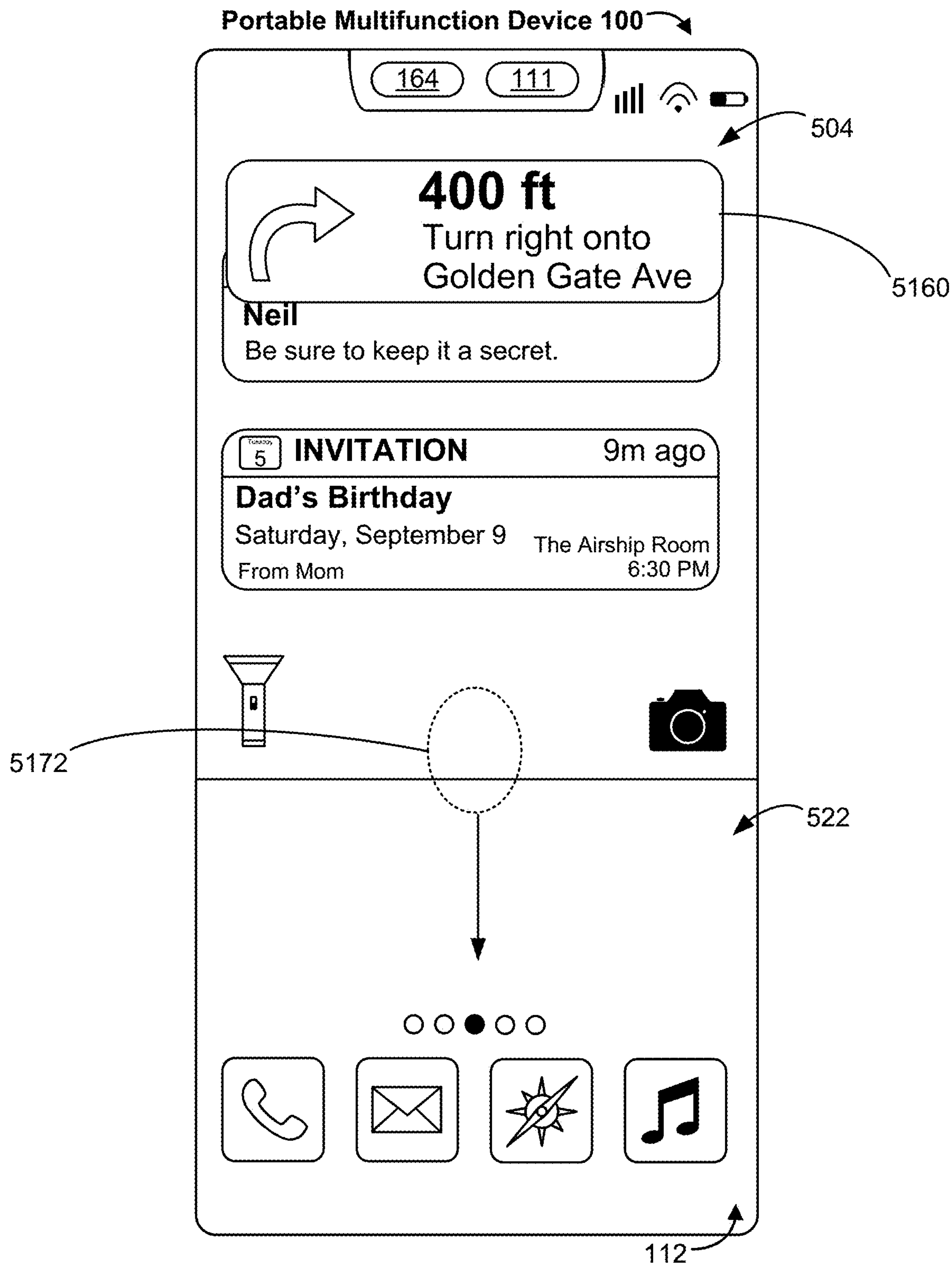

Portable Multifunction Device 100
164
111
5172
522
400 ft
Turn right onto
Golden Gate Ave
5160
280
112

Figure 5DN



Portable Multifunction Device 100
164
111
504
400 ft
Turn right onto
Golden Gate Ave
5160
Neil
Be sure to keep it a secret.
5
INVITATION
9m ago
Dad's Birthday
Saturday, September 9
The Airship Room
From Mom
6:30 PM
5172
522
112

Figure 5DO

Portable Multifunction Device 100
164
111
504
6:29
Tuesday, September 5
400 ft
Turn right onto
Golden Gate Ave
5160
MESSAGES
7m ago
Neil
Be sure to keep it a secret.
5164
INVITATION
9m ago
5
Dad's Birthday
Saturday, September 9
The Airship Room
From Mom
6:30 PM
5168
112

Figure 5DP

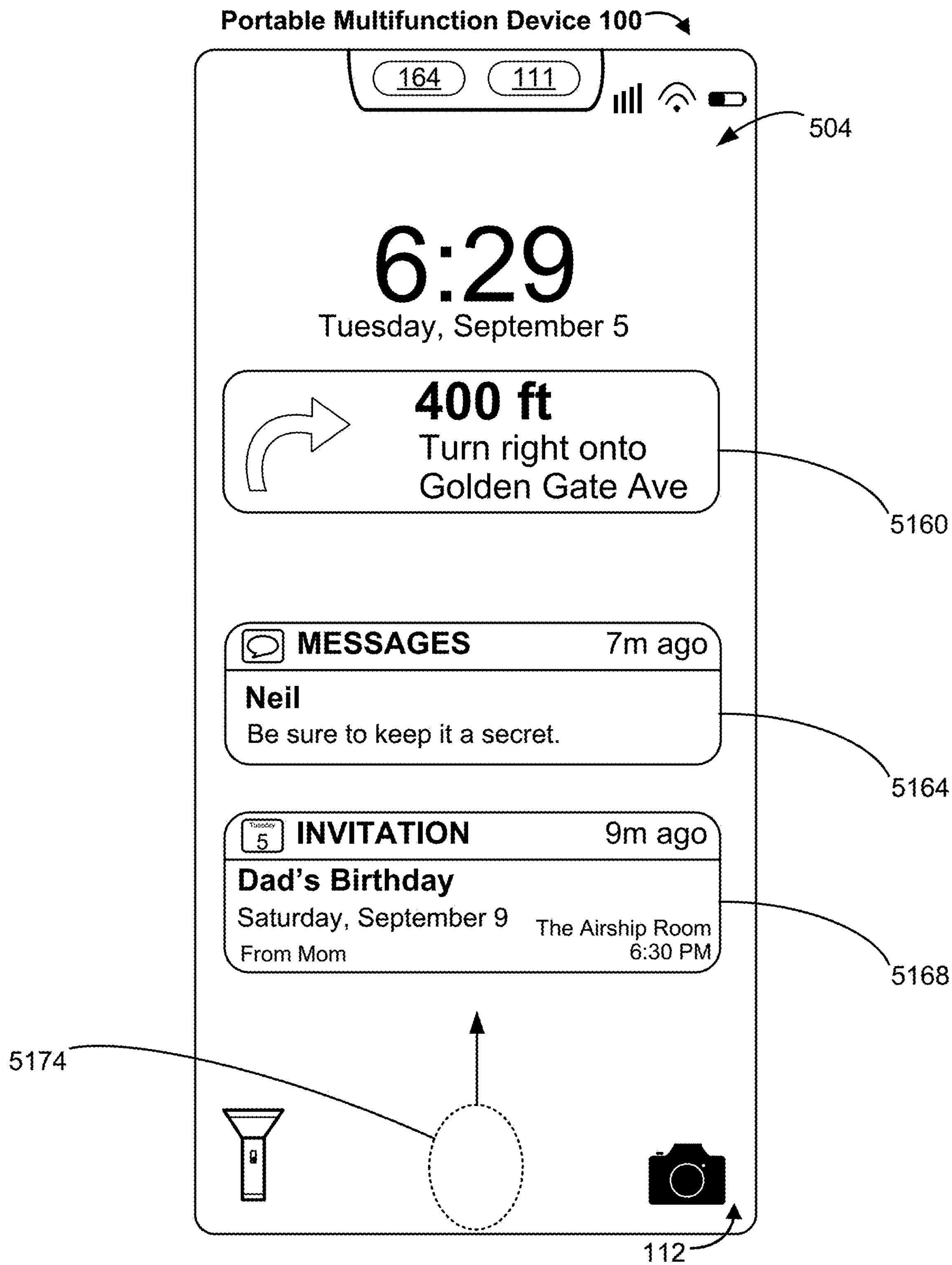

Portable Multifunction Device 100
164
111
504
6:29
Tuesday, September 5
400 ft
Turn right onto
Golden Gate Ave
5160
MESSAGES
7m ago
Neil
Be sure to keep it a secret.
5164
INVITATION
9m ago
Dad's Birthday
Saturday, September 9
From Mom
The Airship Room
6:30 PM
5168
5174
112

Figure 5DQ

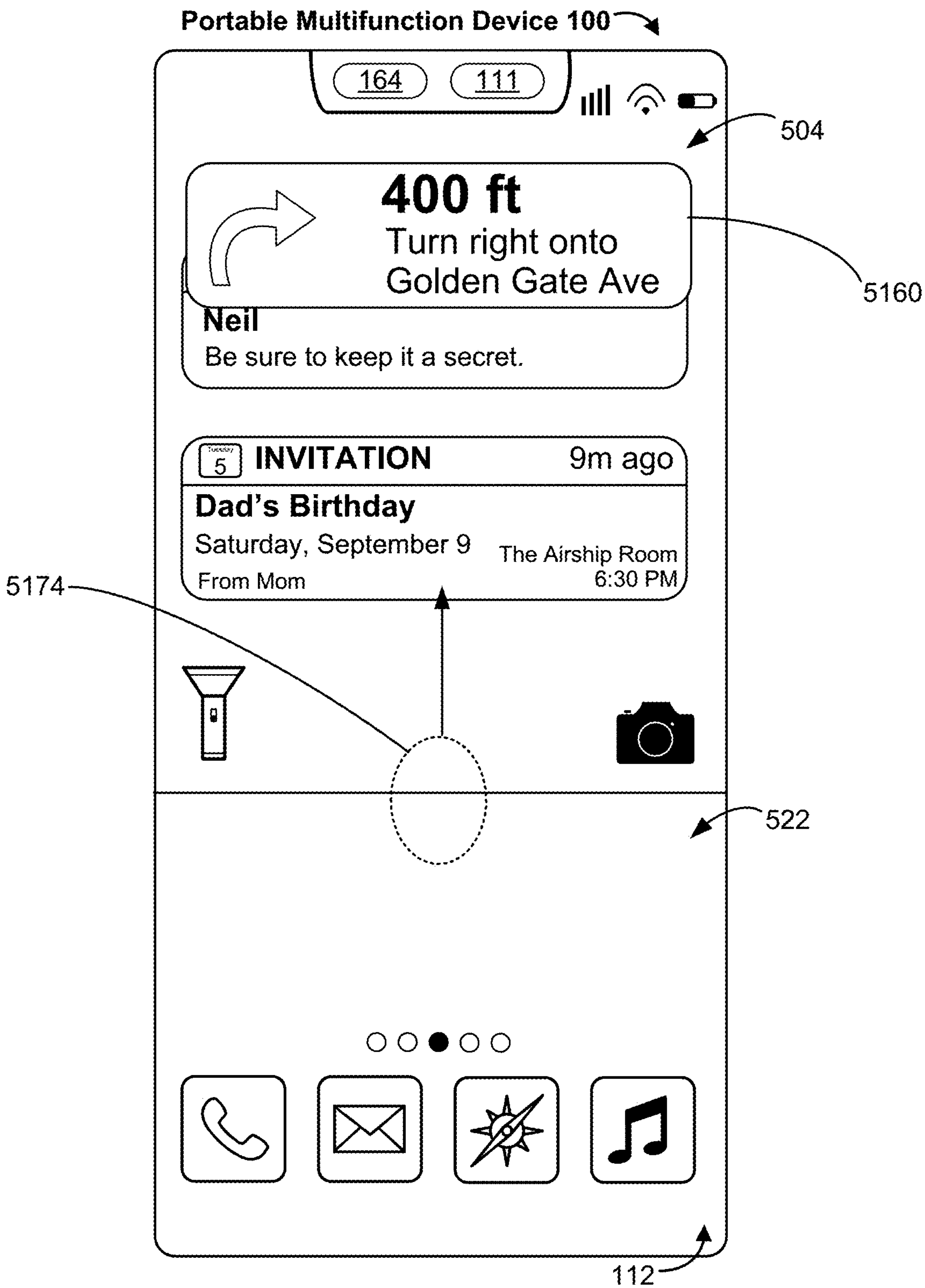

Portable Multifunction Device 100
164
111
504
400 ft
Turn right onto
Golden Gate Ave
5160
Neil
Be sure to keep it a secret.
5
INVITATION
9m ago
Dad's Birthday
Saturday, September 9
From Mom
The Airship Room
6:30 PM
5174
522
112

Figure 5DR

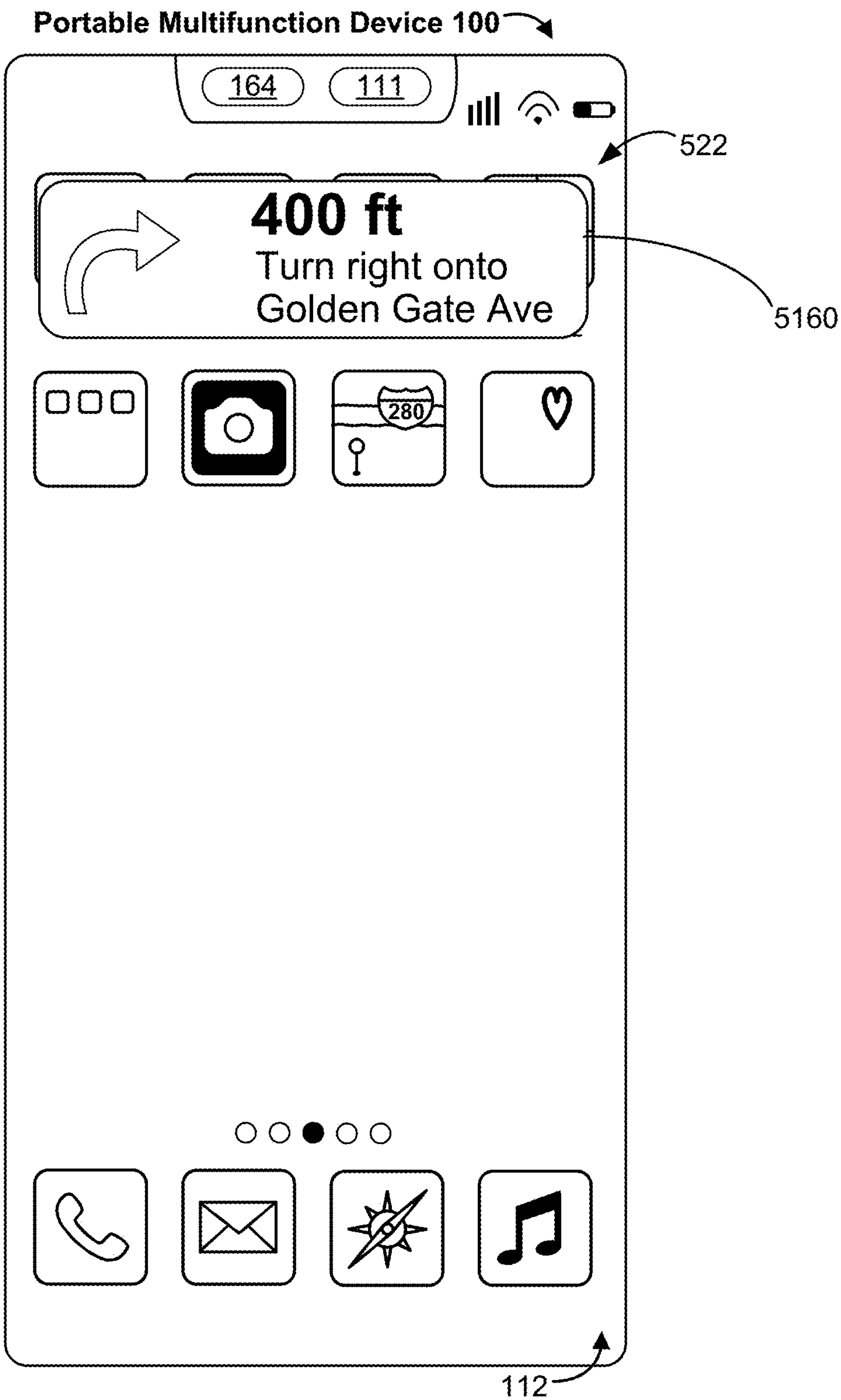

Portable Multifunction Device 100
164
111
522
400 ft
Turn right onto
Golden Gate Ave
5160
280
112

Figure 5DS

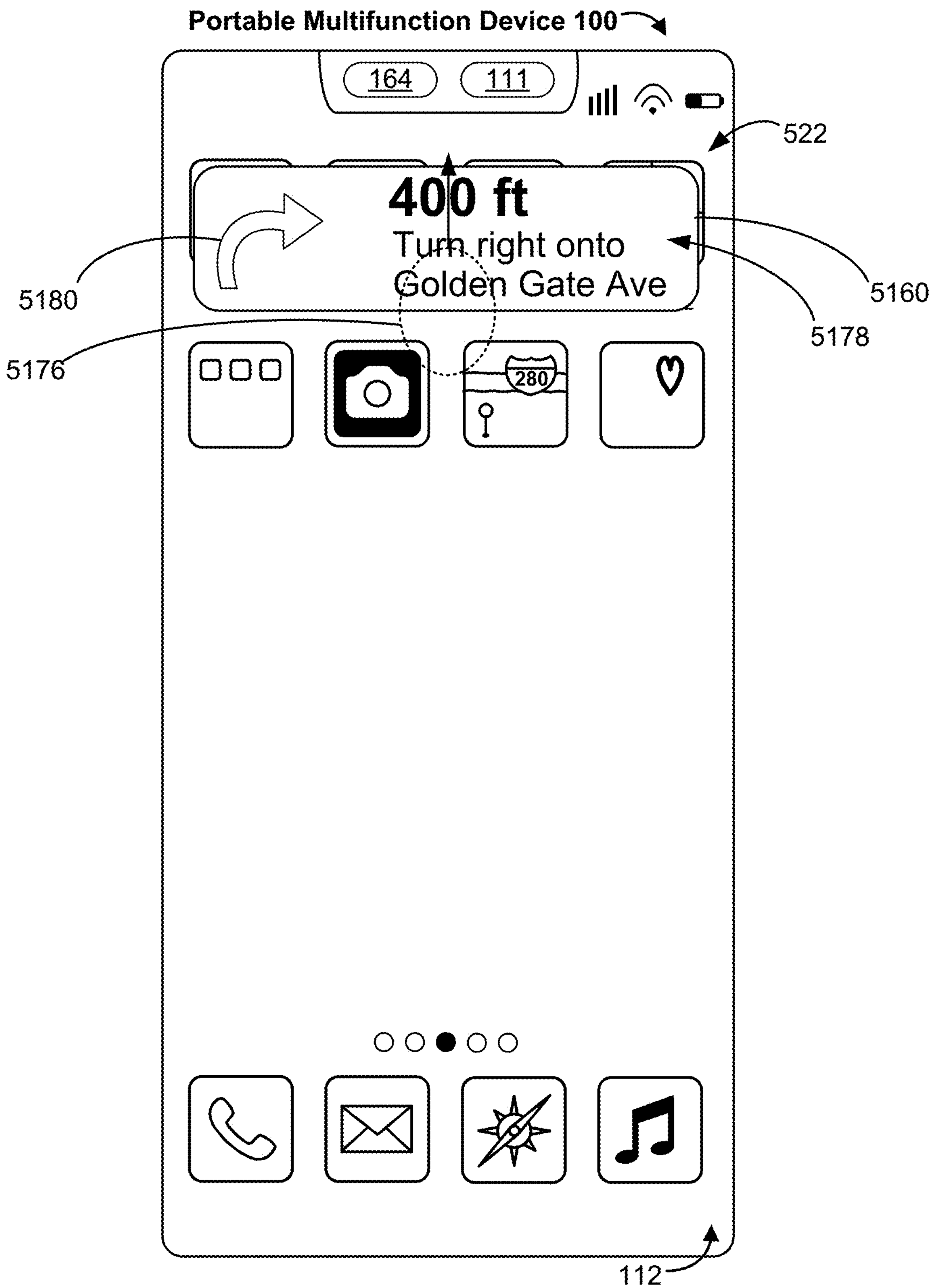

Portable Multifunction Device 100
164
111
522
400 ft
Turn right onto
Golden Gate Ave
5180
5160
5178
5176
280
112

Figure 5DT

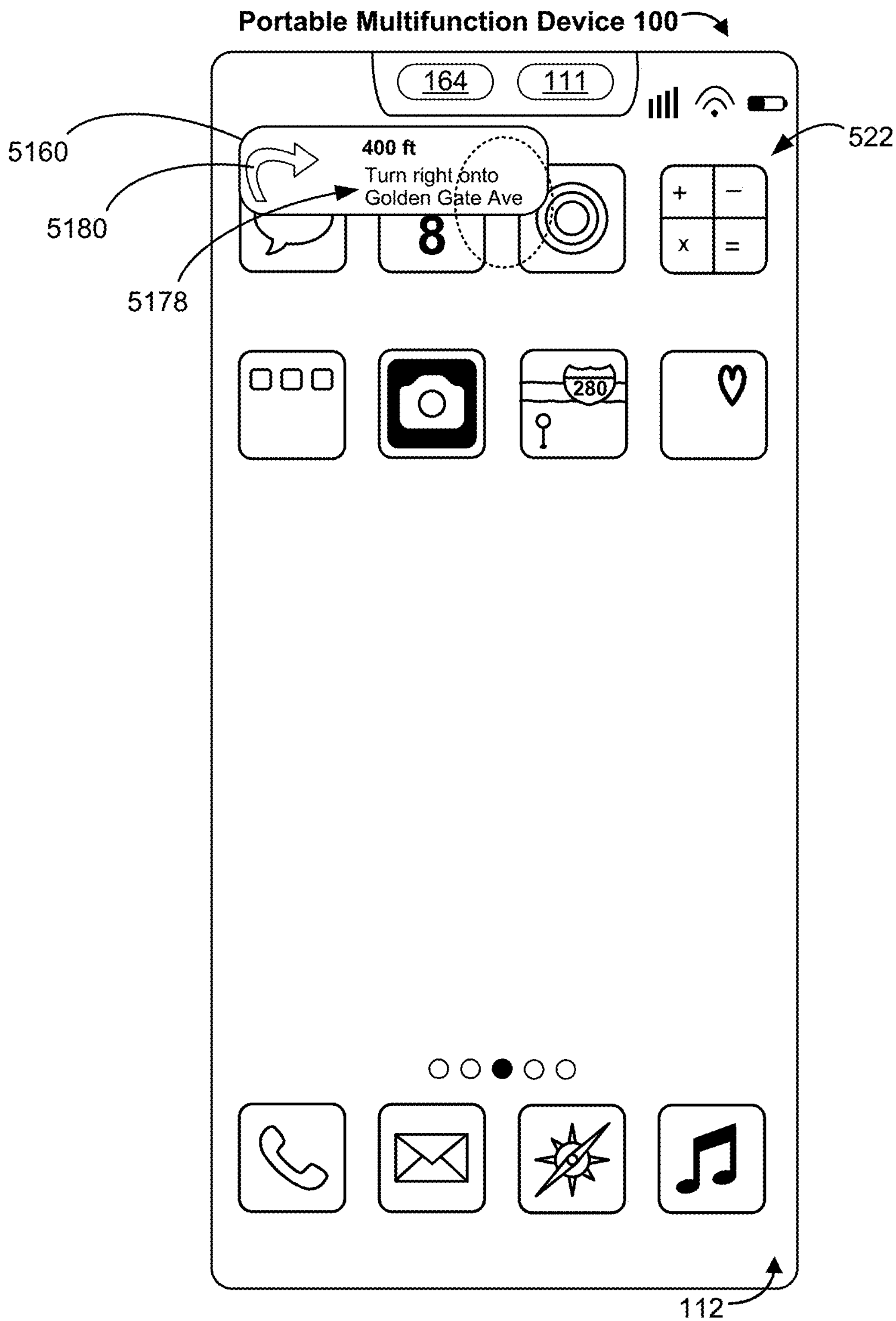
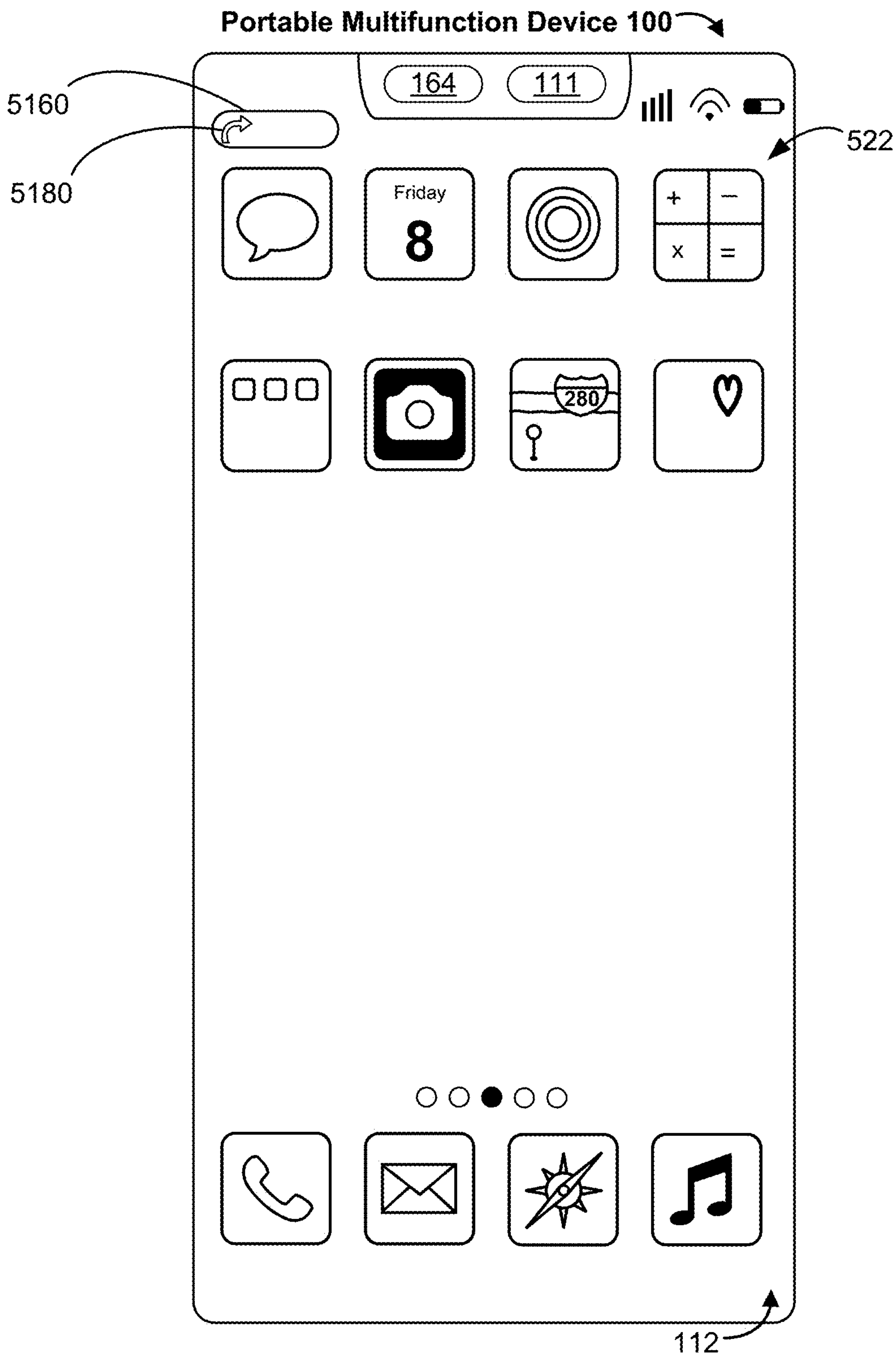

Portable Multifunction Device 100
164
111
522
5160
5180
5178
400 ft
Turn right onto
Golden Gate Ave
8
+
−
x
=
280
112

Figure 5DU



Portable Multifunction Device 100
5160
5180
164
111
522
Friday
8
+
−
x
=
280
112

Figure 5DV

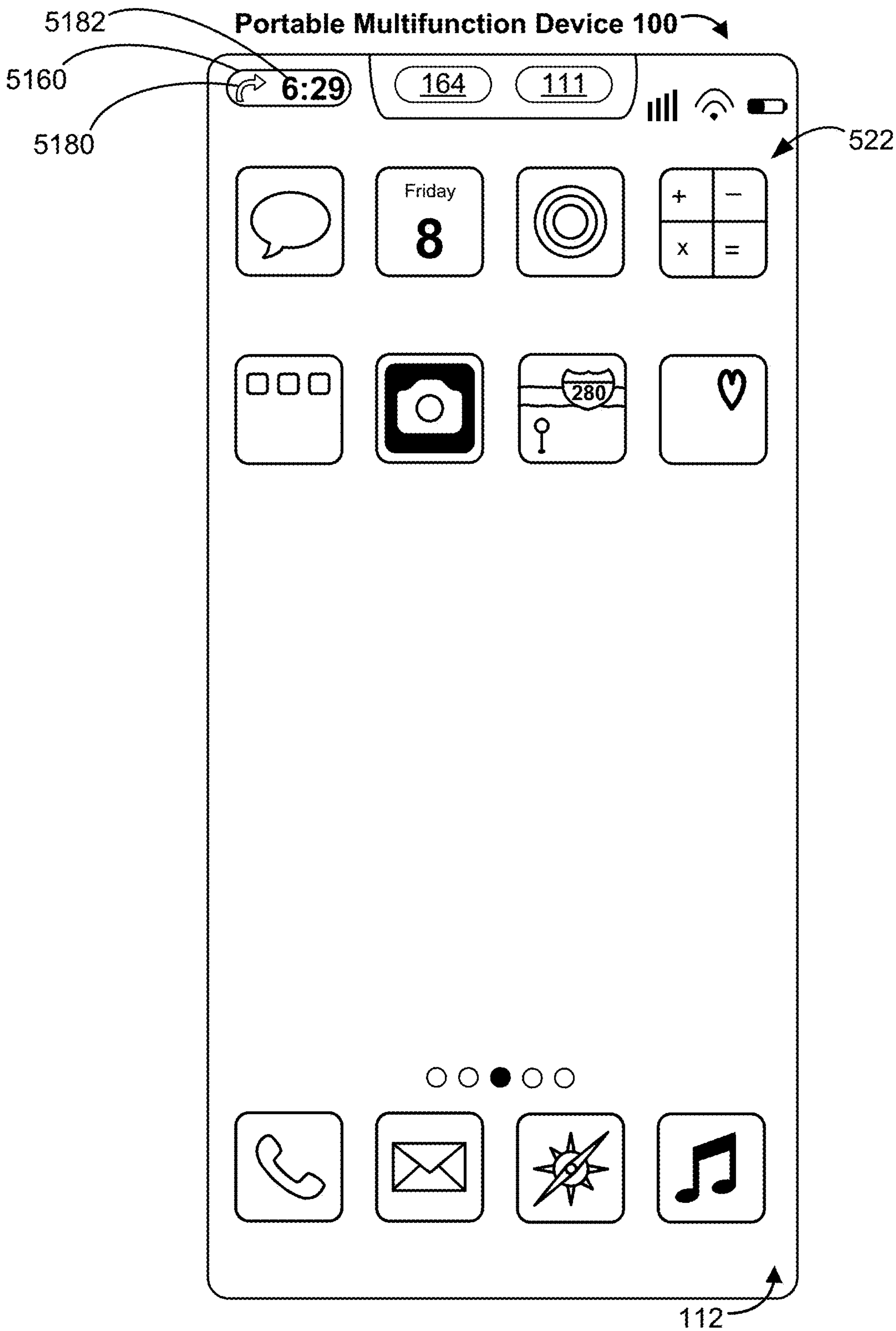
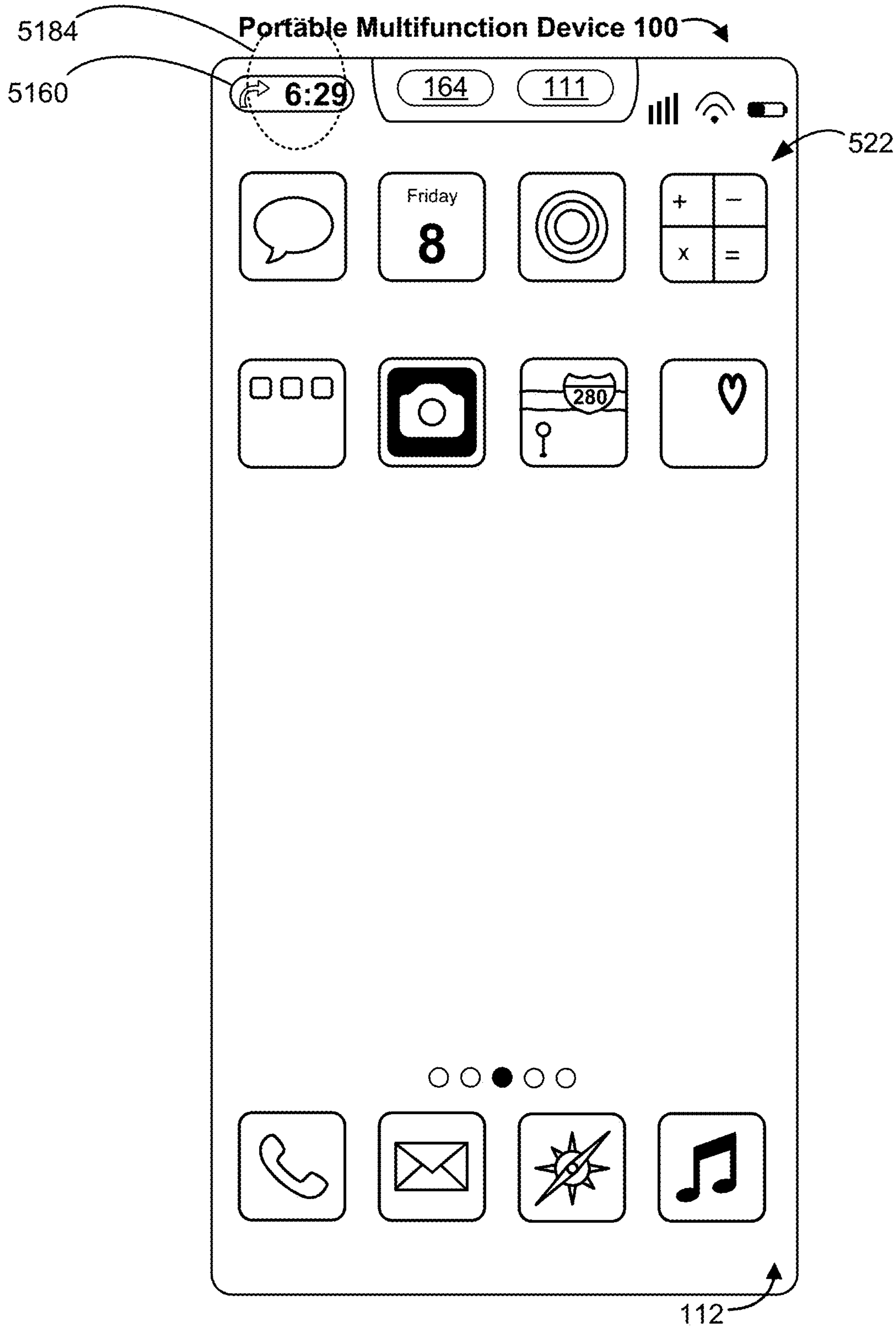

Portable Multifunction Device 100
5182
5160
5180
6:29
164
111
522
Friday
8
280
112

Figure 5DW



5184
5160
Portable Multifunction Device 100
6:29
164
111
522
Friday
8
+
−
x
=
280
112

Figure 5DX

Portable Multifunction Device 100
6:29 PM
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
5160
Turk St
Golden Gate Ave
Fulton St
Alamo Square
Grove St
Fell St
Panhandle
Page St
Haight St
To Apple Chestnut Str...
16 min
End
112

Figure 5DY

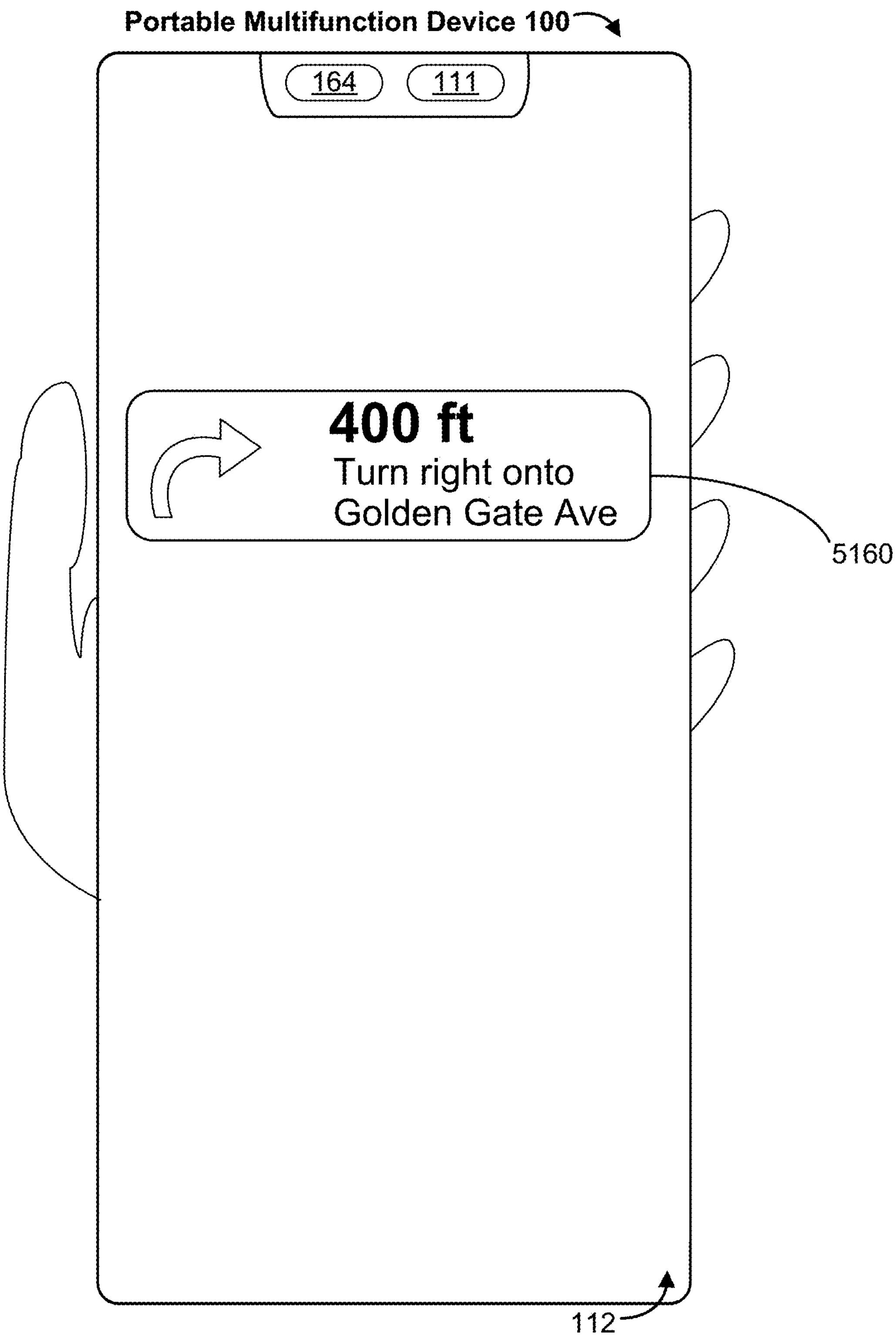

Portable Multifunction Device 100
164
111
400 ft
Turn right onto
Golden Gate Ave
5160
112

Figure 5DZ

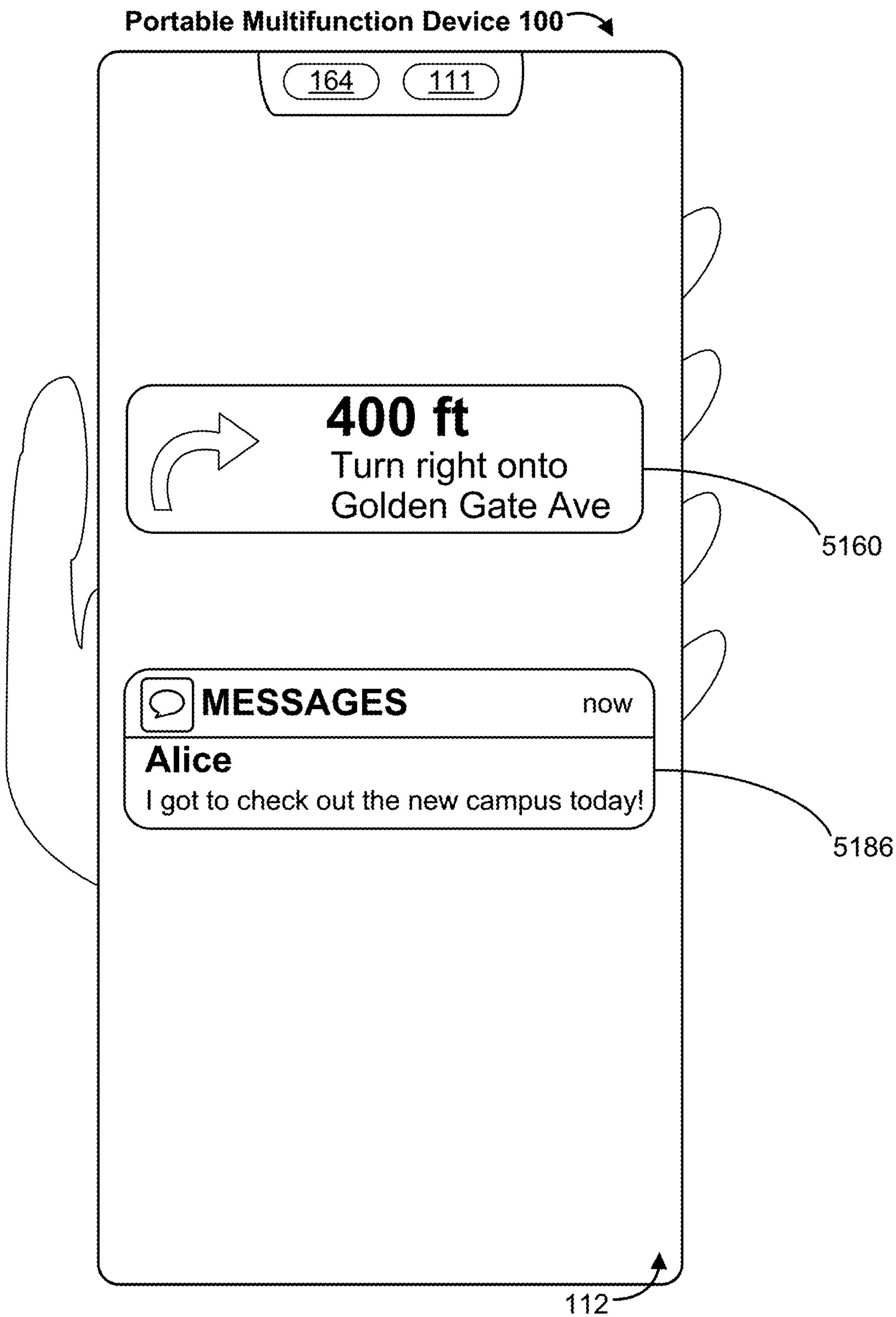

Portable Multifunction Device 100
164
111
400 ft
Turn right onto
Golden Gate Ave
5160
MESSAGES
now
Alice
I got to check out the new campus today!
5186
112

Figure 5EA

Portable Multifunction Device 100
6:29 PM
164
111
504
6:29
Tuesday, September 5
400 ft
Turn right onto
Golden Gate Ave
5160
MESSAGES
now
Alice
I got to check out the new campus today!
MESSAGES
7m ago
Neil
Be sure to keep it a secret.
INVITATION
9m ago
5
Dad's Birthday
Saturday, September 9
From Mom
The Airship Room
6:30 PM
112

Figure 5EB

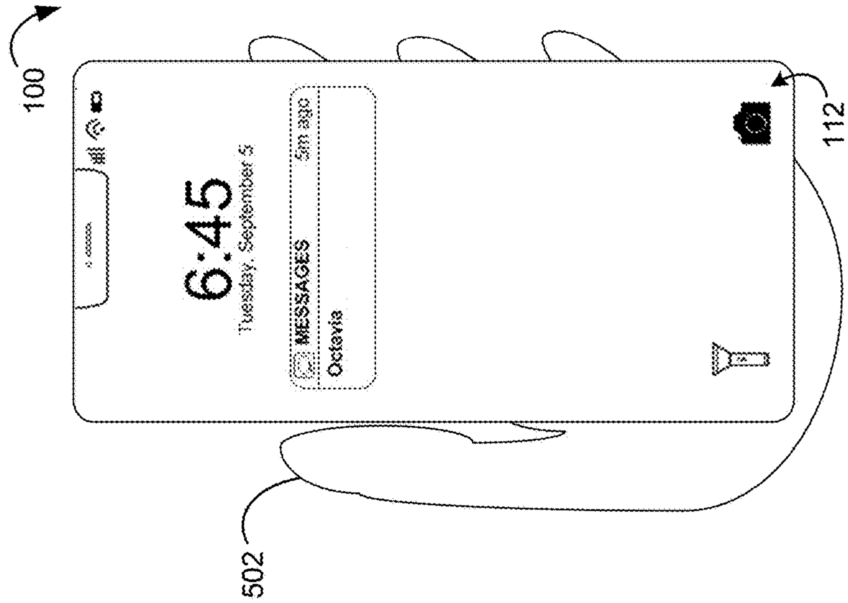


Figure 5EC4

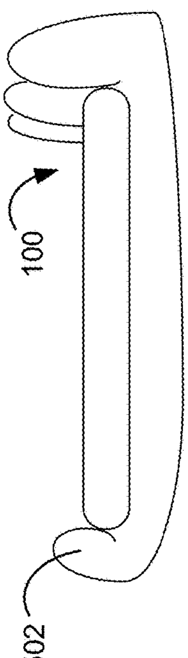


Figure 5EC1

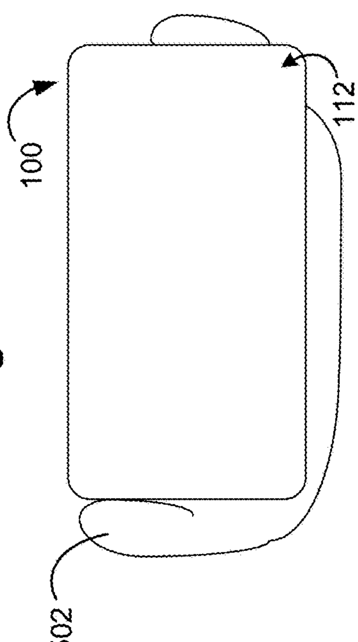


Figure 5EC2

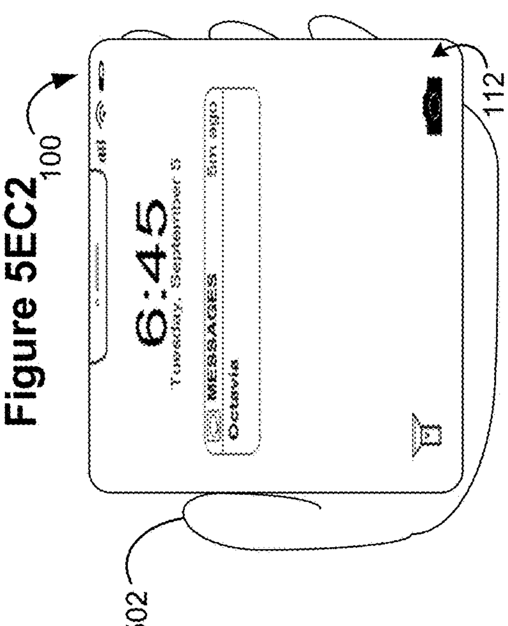
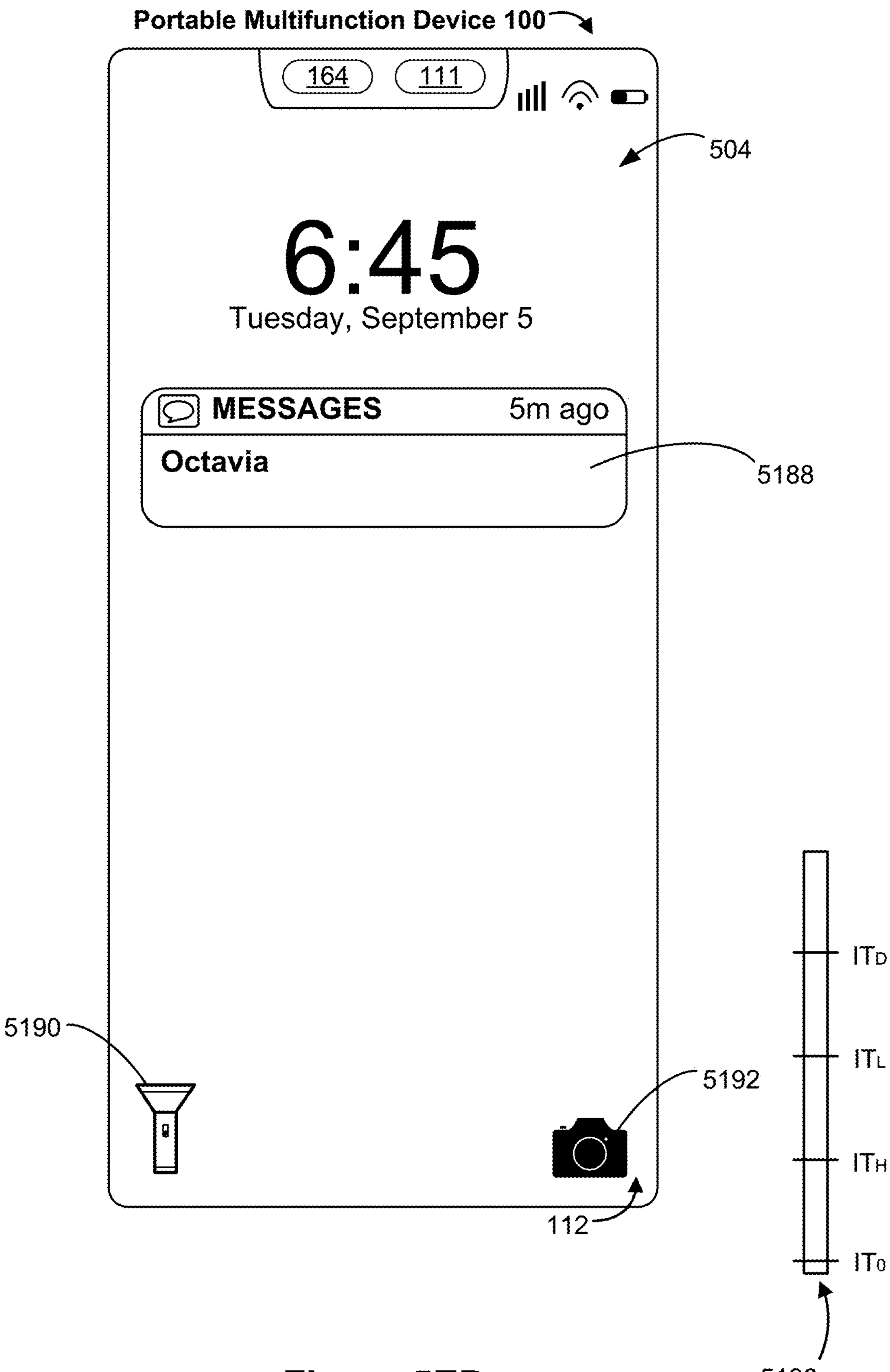


Figure 5EC3



Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5188
5190
5192
112
ITD
ITL
ITH
IT0
5196

Figure 5ED

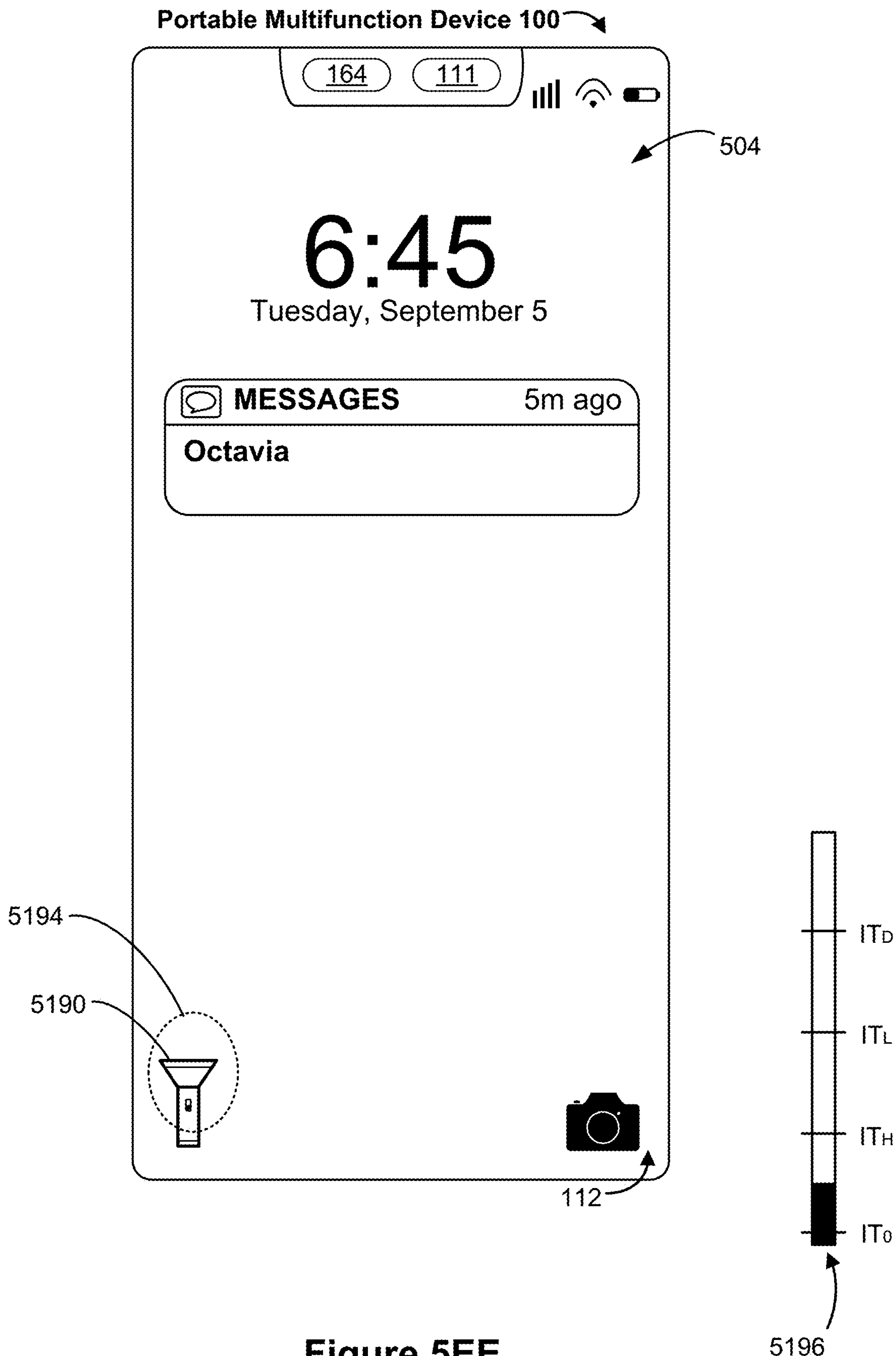

Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5194
5190
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5EE

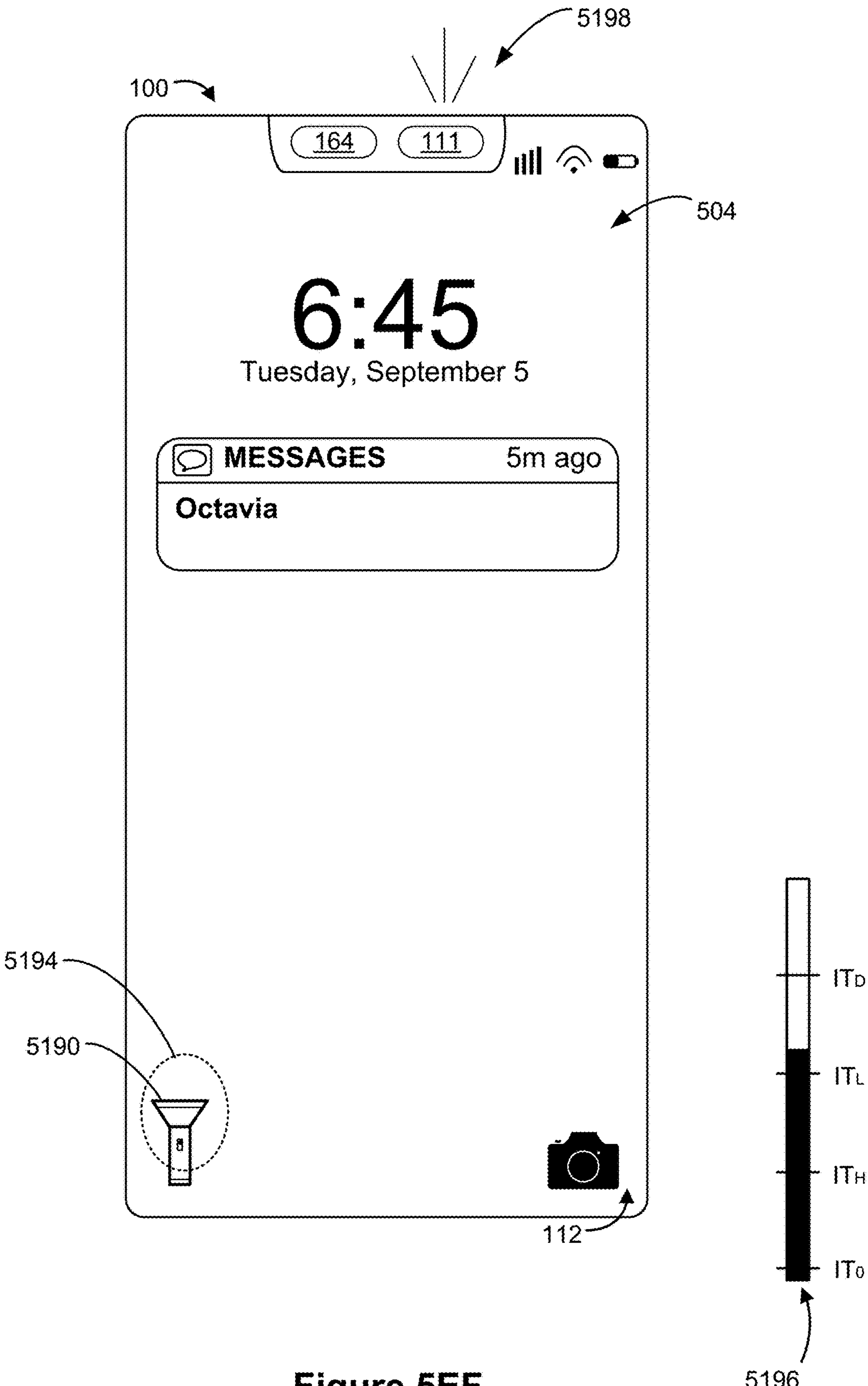

5198
100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5194
5190
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5EF

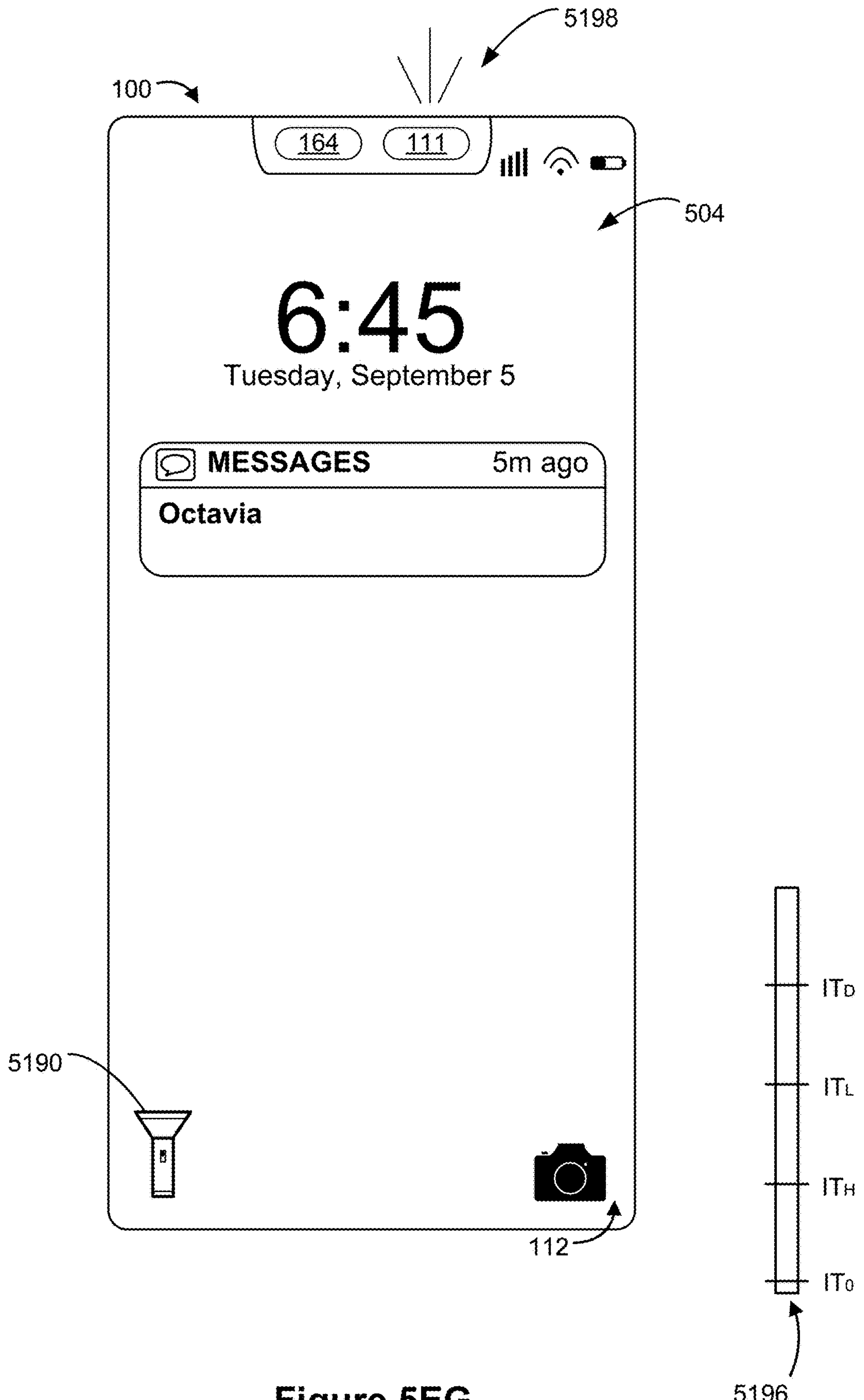
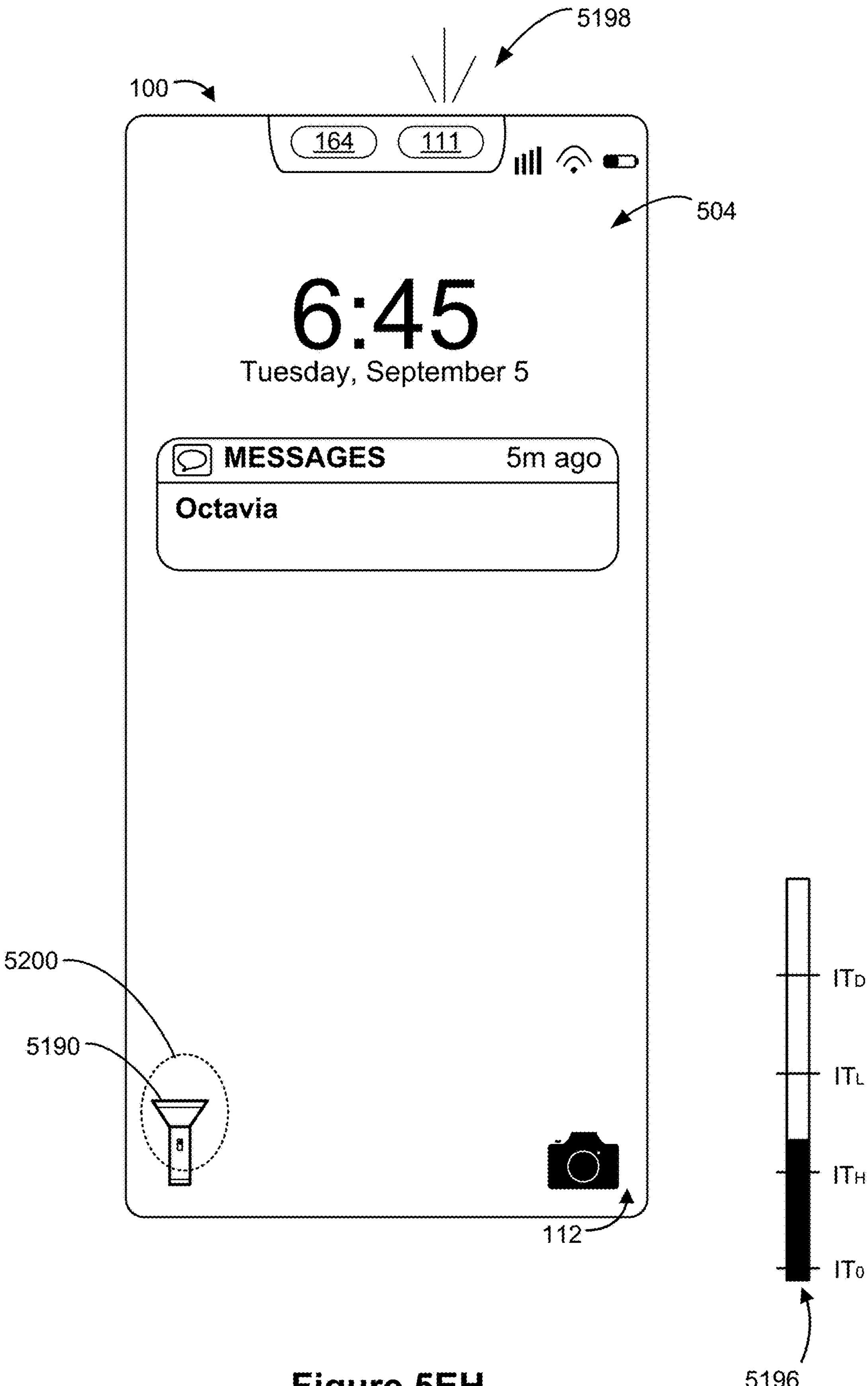

5198
100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5190
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5EG



5198
100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5200
5190
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5EH

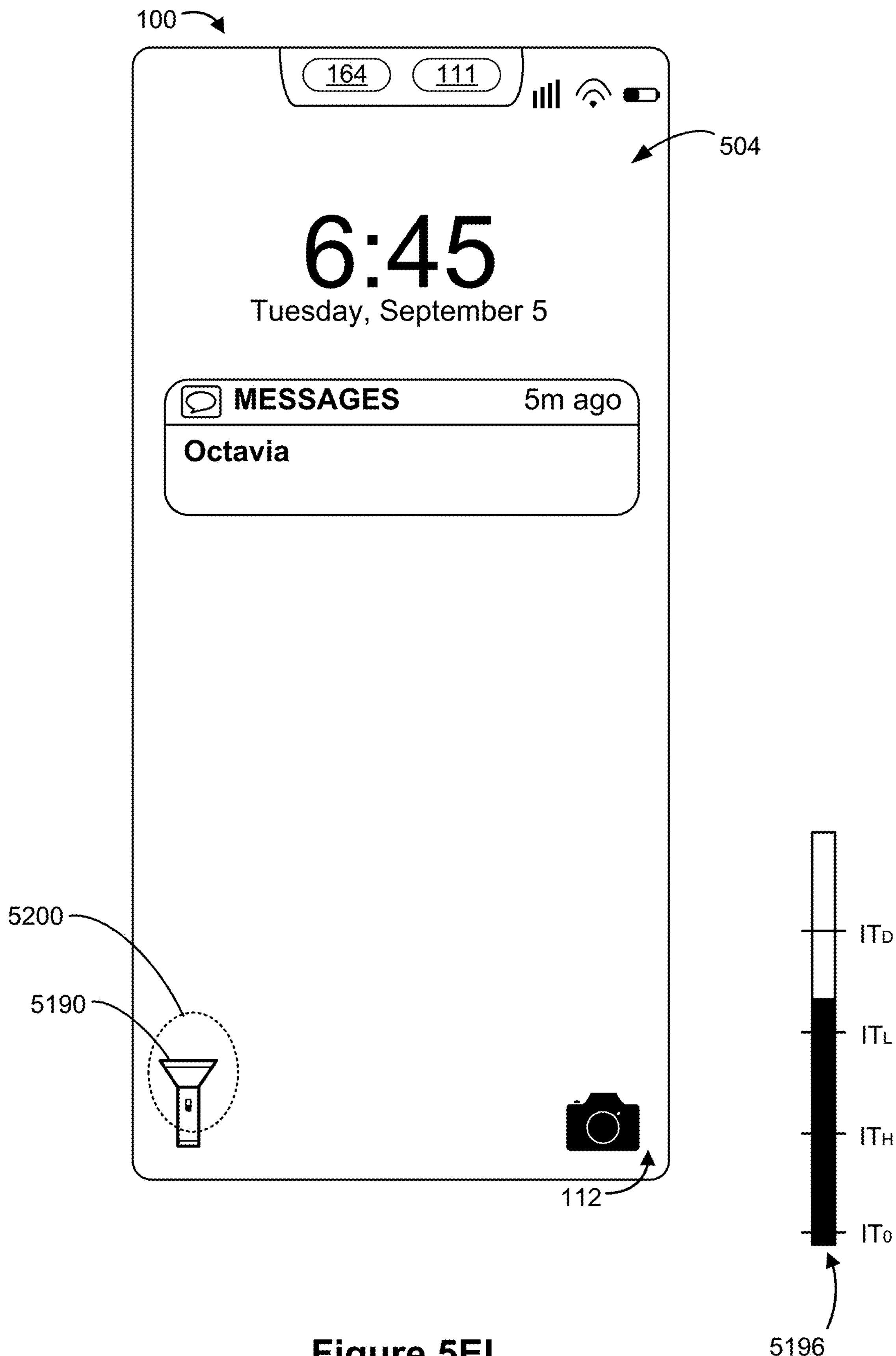

100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5200
5190
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5EI

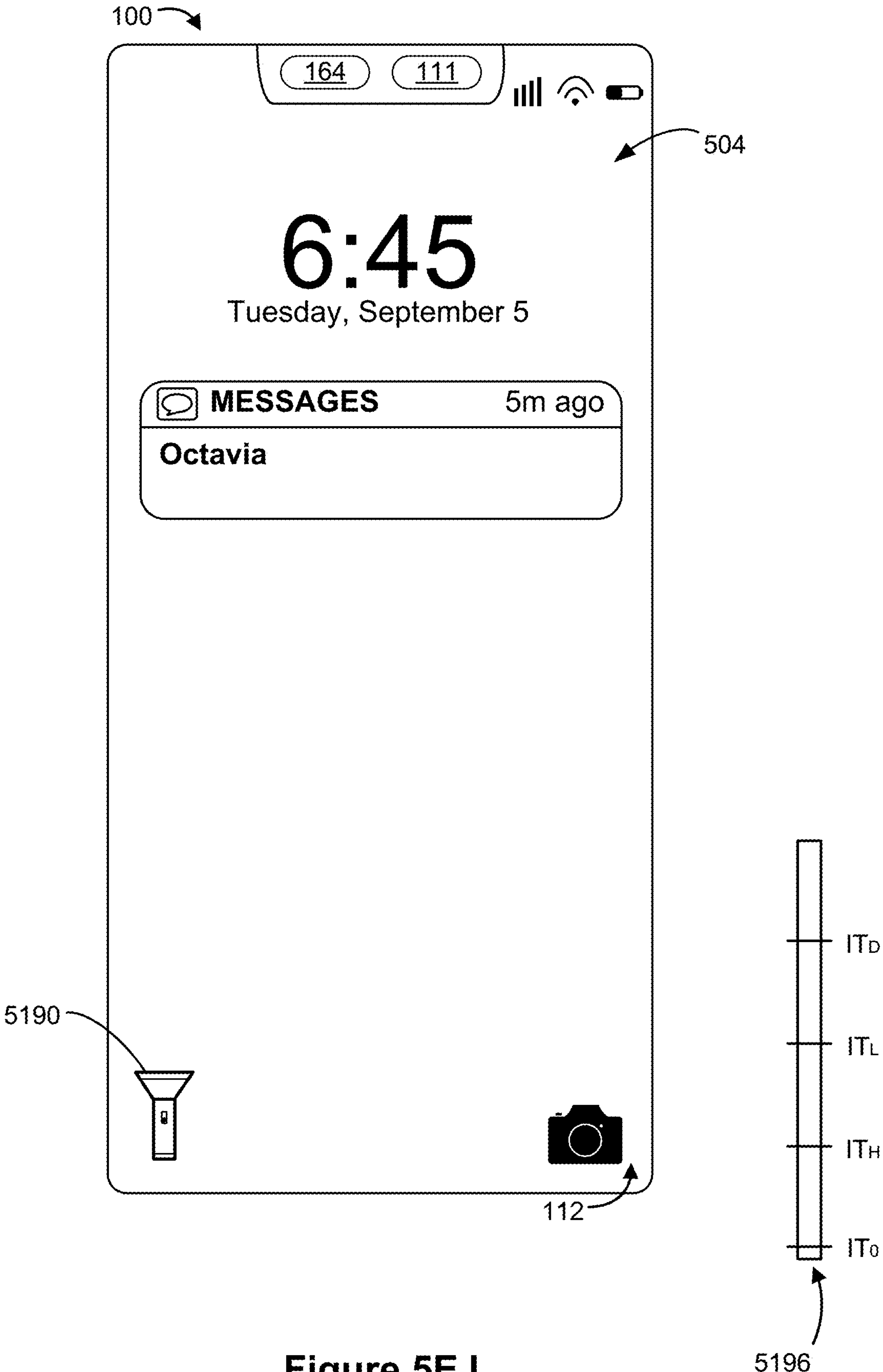
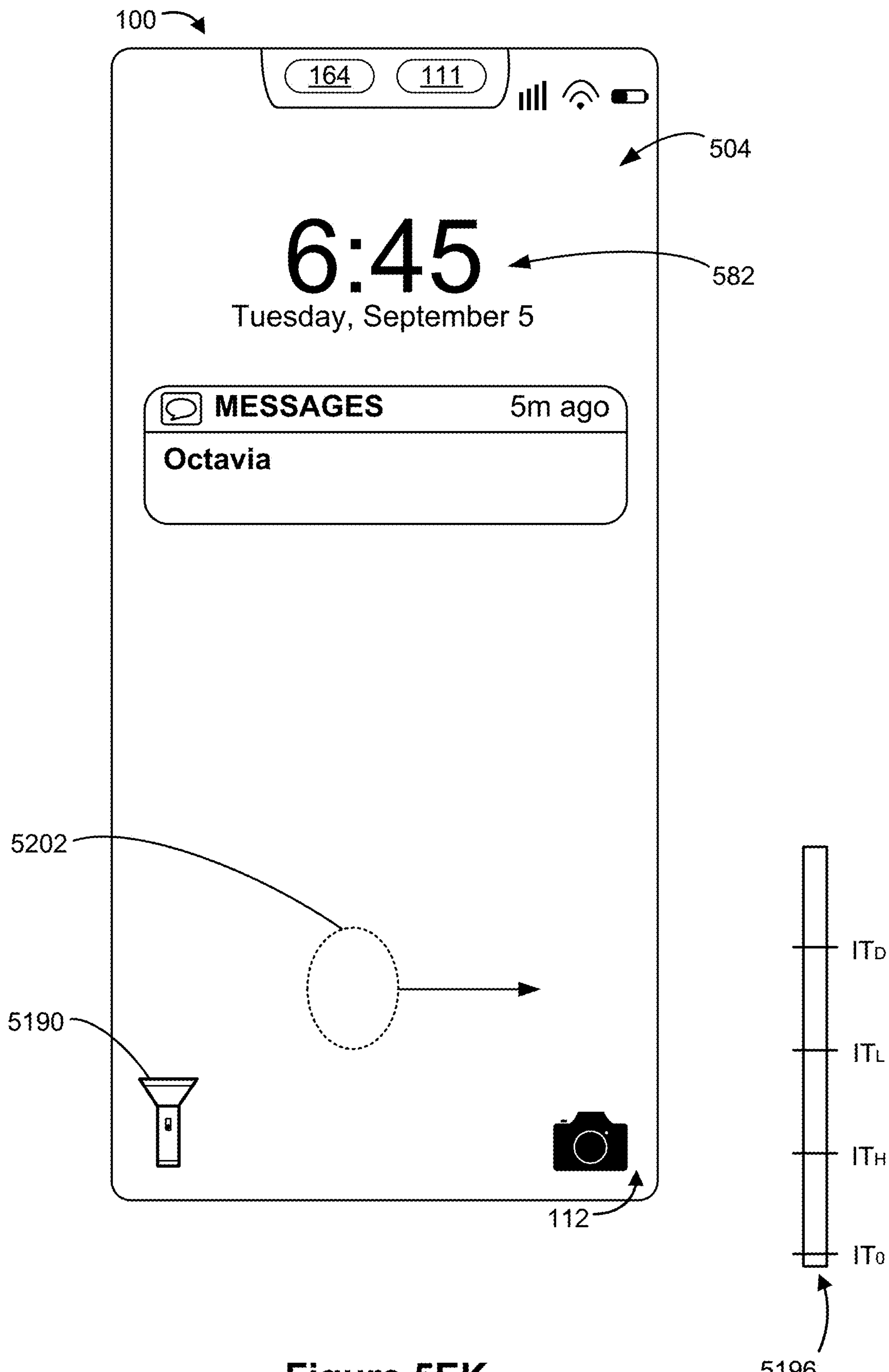
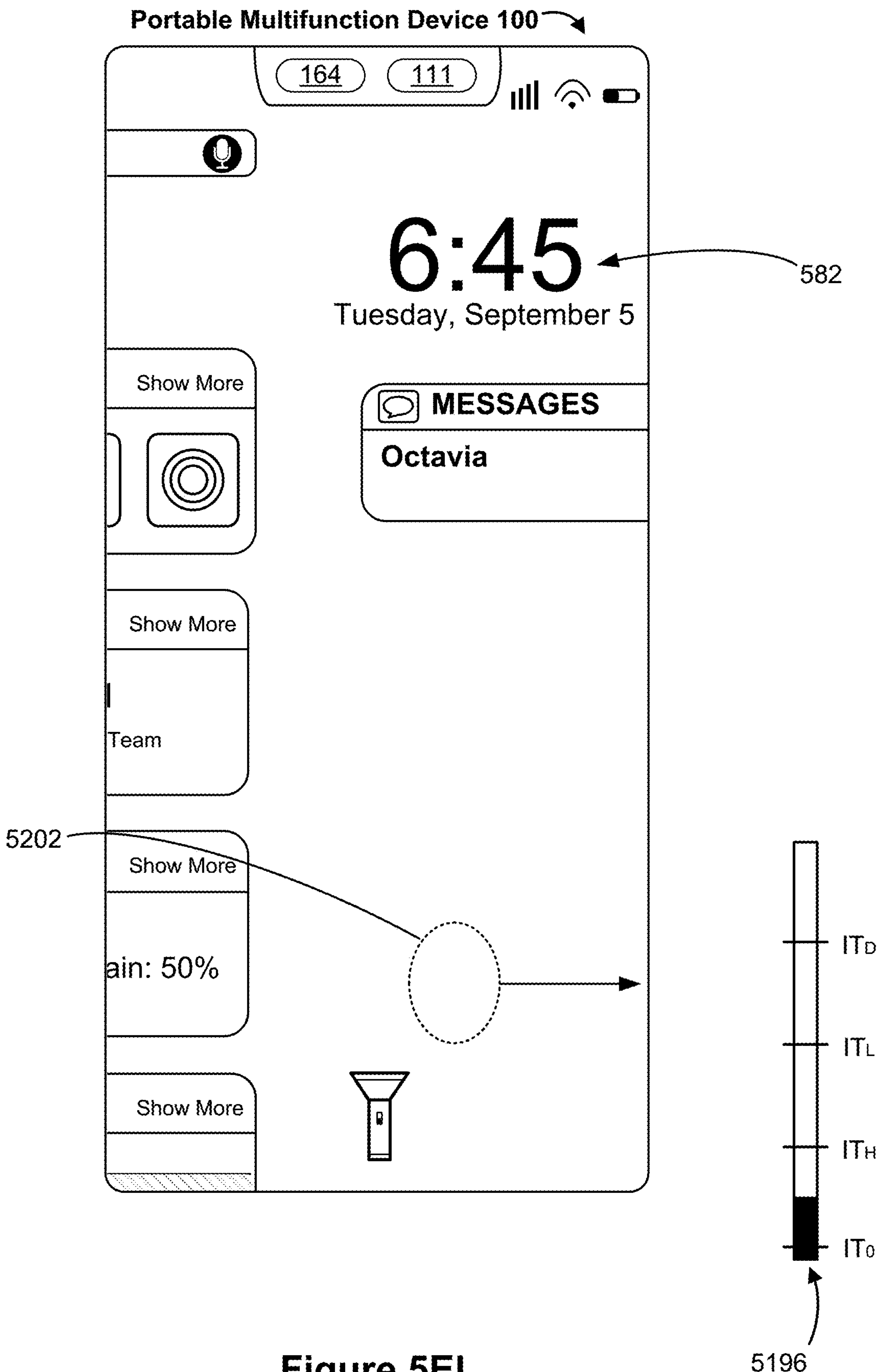

100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5190
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5EJ



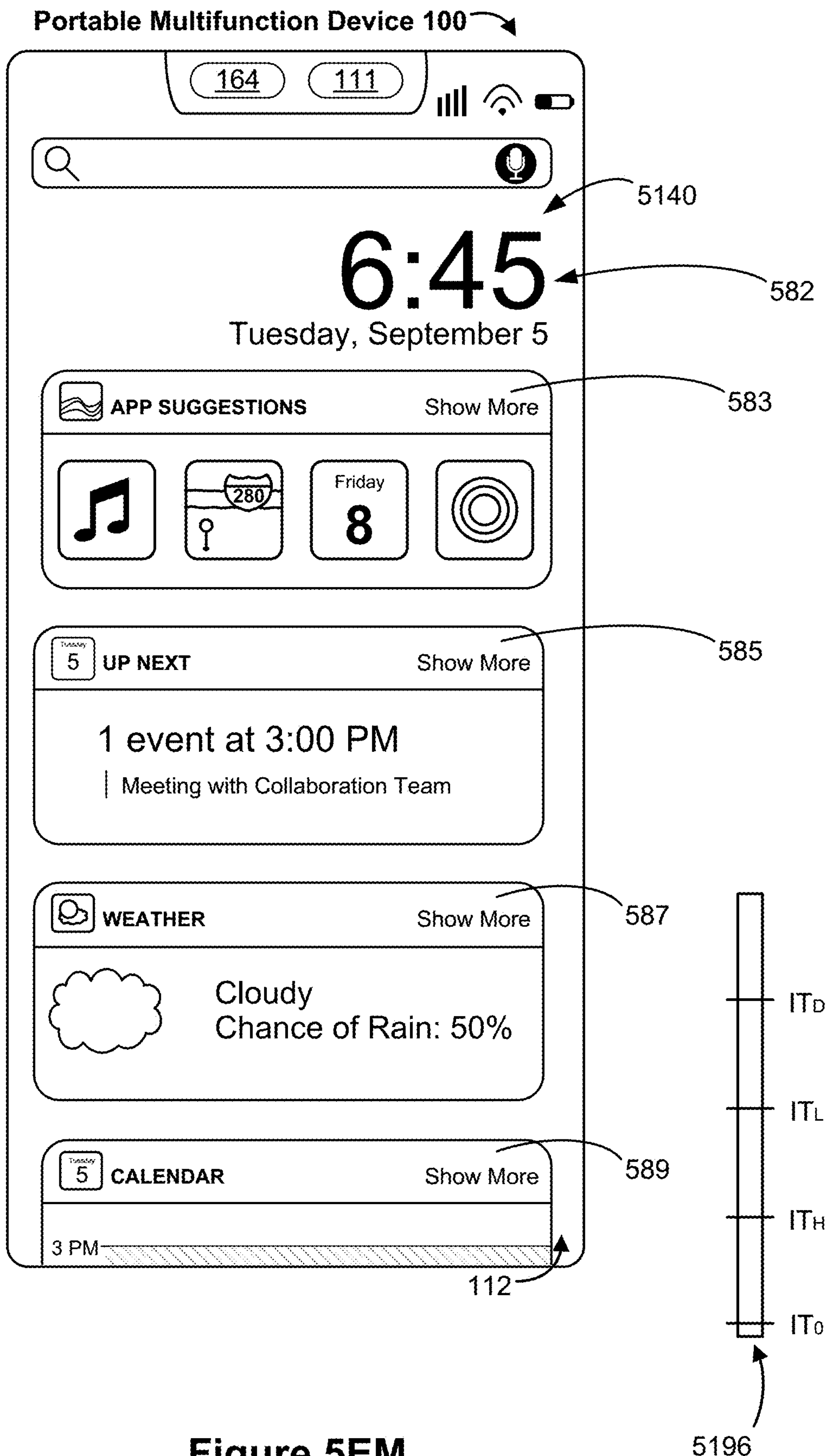
100
164
111
504
6:45
582
Tuesday, September 5
MESSAGES
5m ago
Octavia
5202
5190
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5EK



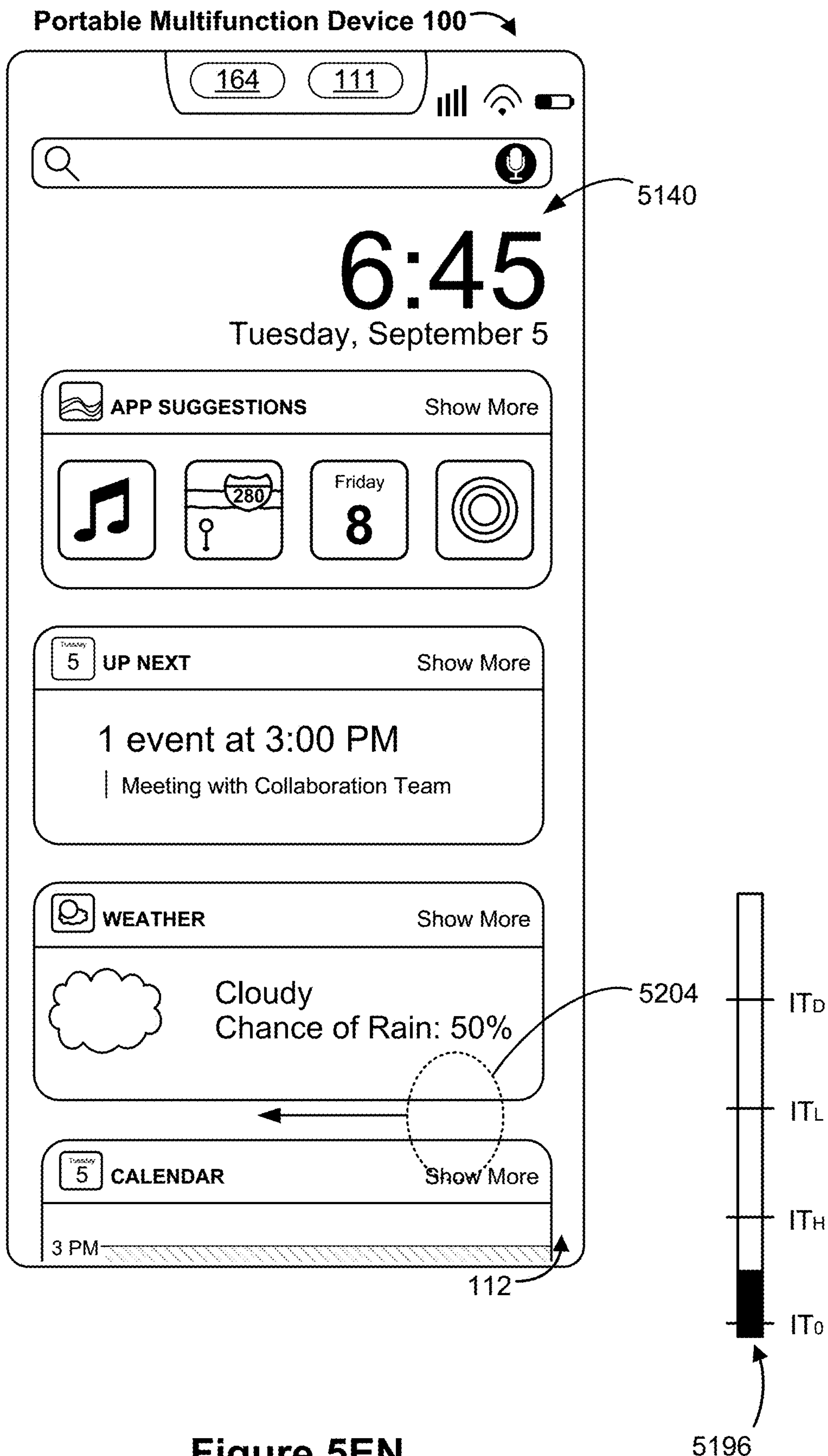
Portable Multifunction Device 100
164
111
6:45
Tuesday, September 5
582
Show More
MESSAGES
Octavia
Show More
Team
5202
Show More
ain: 50%
Show More
IT_D
IT_L
IT_H
IT_0
5196

Figure 5EL



Portable Multifunction Device 100
164
111
5140
6:45
582
Tuesday, September 5
APP SUGGESTIONS
Show More
583
280
Friday
8
5
UP NEXT
Show More
585
1 event at 3:00 PM
Meeting with Collaboration Team
WEATHER
Show More
587
Cloudy
Chance of Rain: 50%
5
CALENDAR
Show More
589
3 PM
112
ITD
ITL
ITH
IT0
5196

Figure 5EM



Portable Multifunction Device 100
164
111
5140
6:45
Tuesday, September 5
APP SUGGESTIONS
Show More
280
Friday
8
5
UP NEXT
Show More
1 event at 3:00 PM
Meeting with Collaboration Team
WEATHER
Show More
Cloudy
Chance of Rain: 50%
5204
5
CALENDAR
Show More
3 PM
112
ITD
ITL
ITH
IT0
5196

Figure 5EN

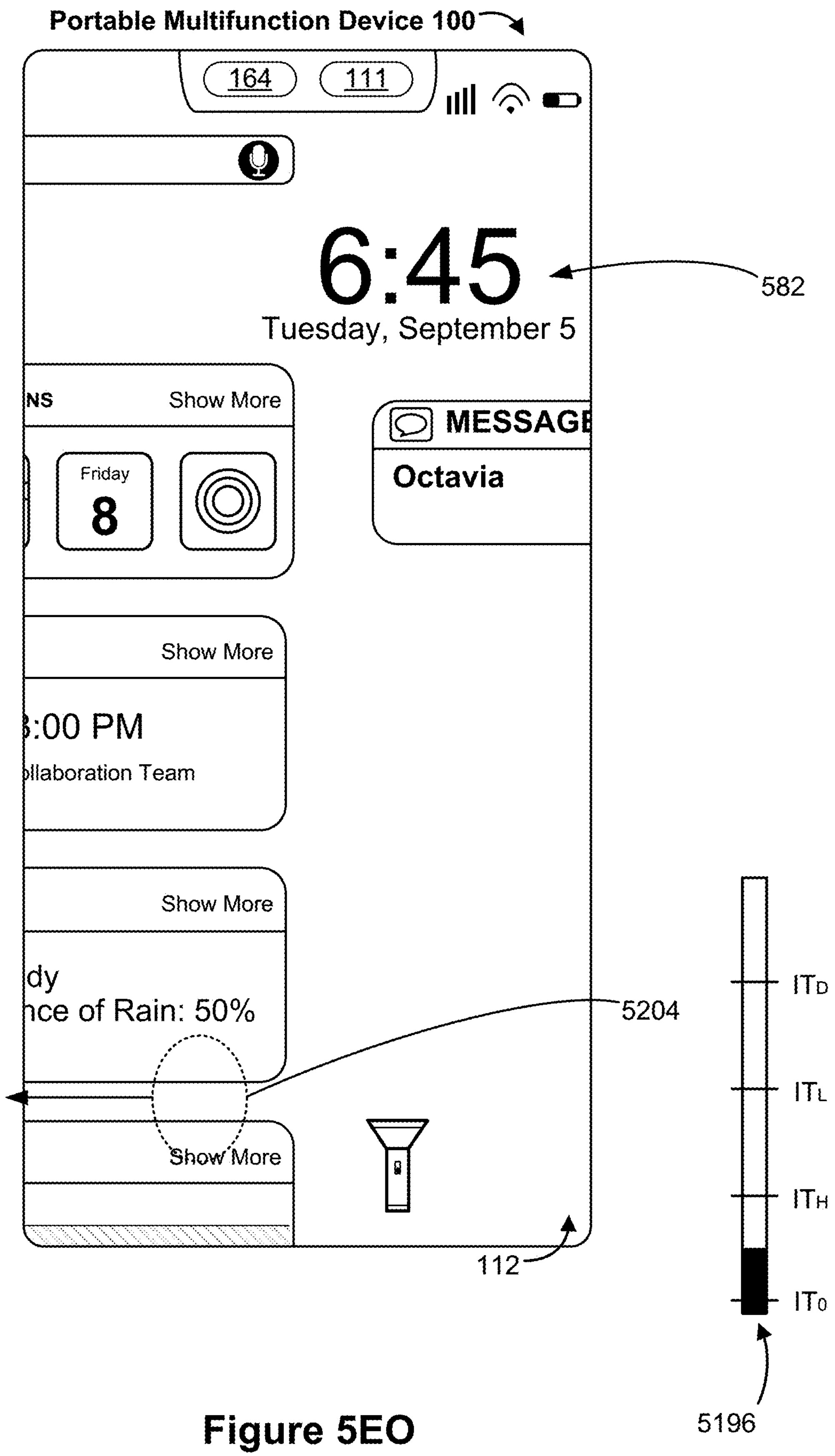
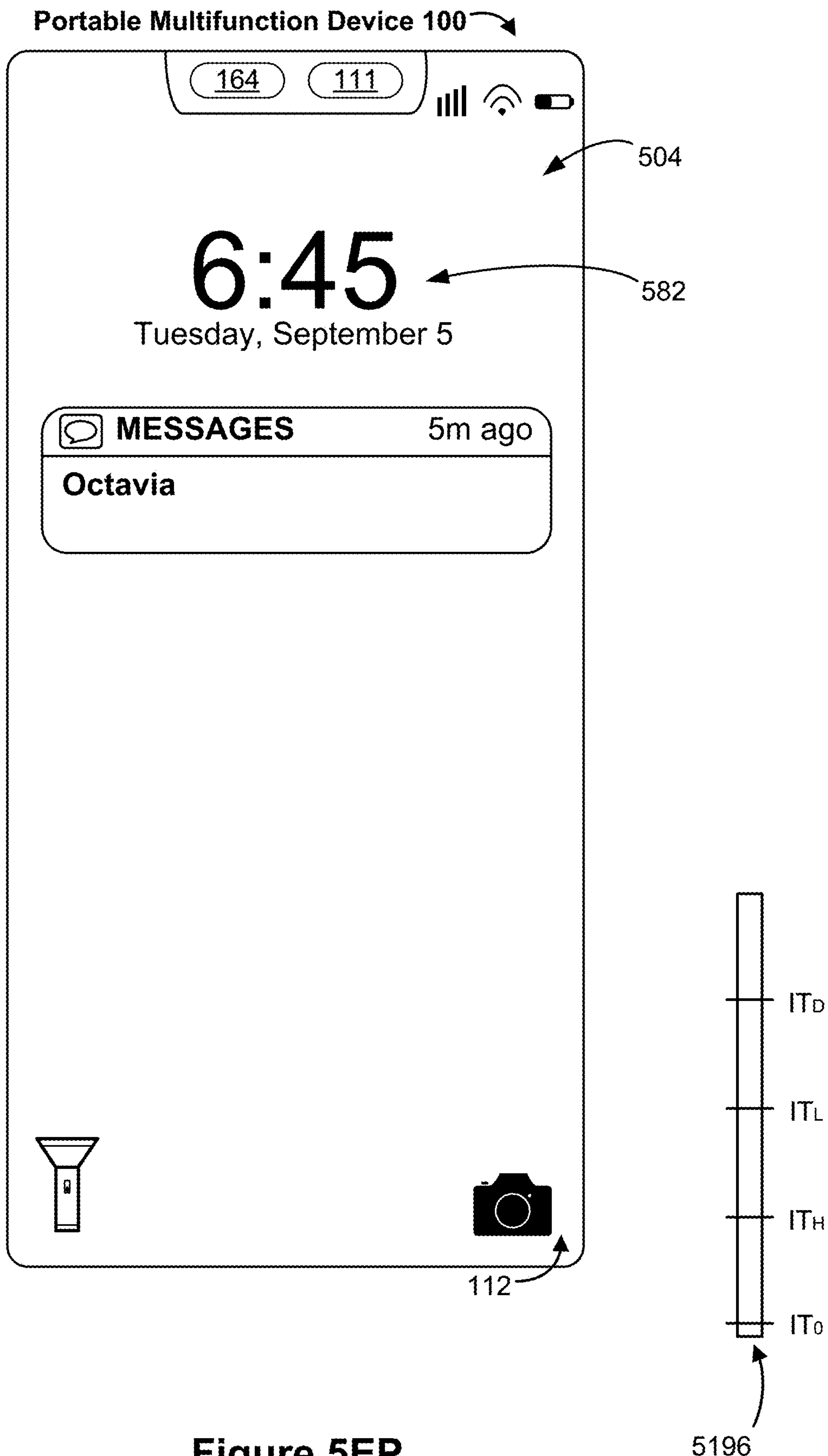

Portable Multifunction Device 100
164
111
6:45
Tuesday, September 5
582
NS
Show More
Friday
8
MESSAGE
Octavia
Show More
:00 PM
llaboration Team
Show More
dy
nce of Rain: 50%
5204
Show More
112
ITD
ITL
ITH
IT0
5196

Figure 5EO



Portable Multifunction Device 100
164
111
504
6:45
582
Tuesday, September 5
MESSAGES
5m ago
Octavia
112
ITD
ITL
ITH
IT0
5196

Figure 5EP

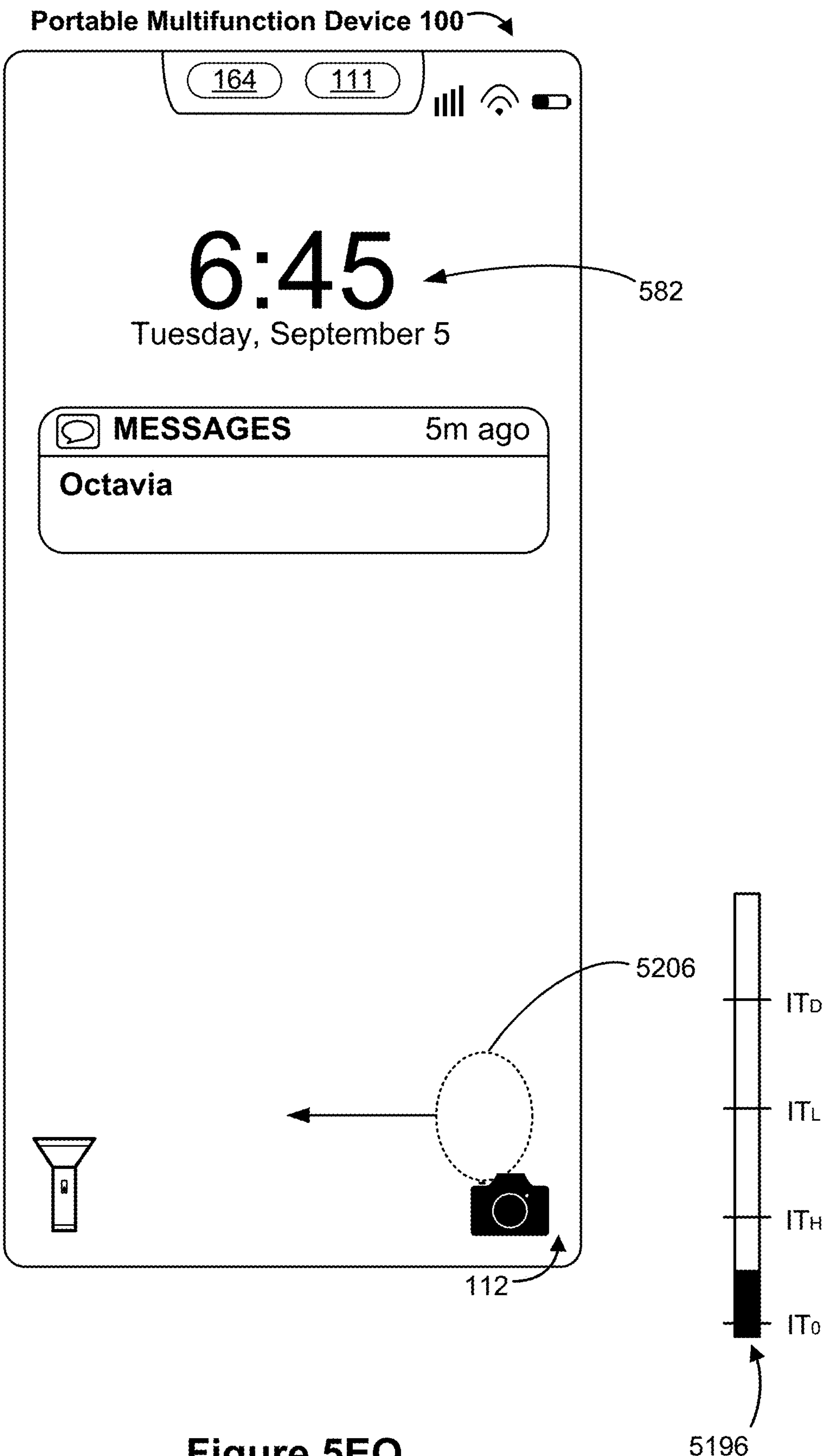
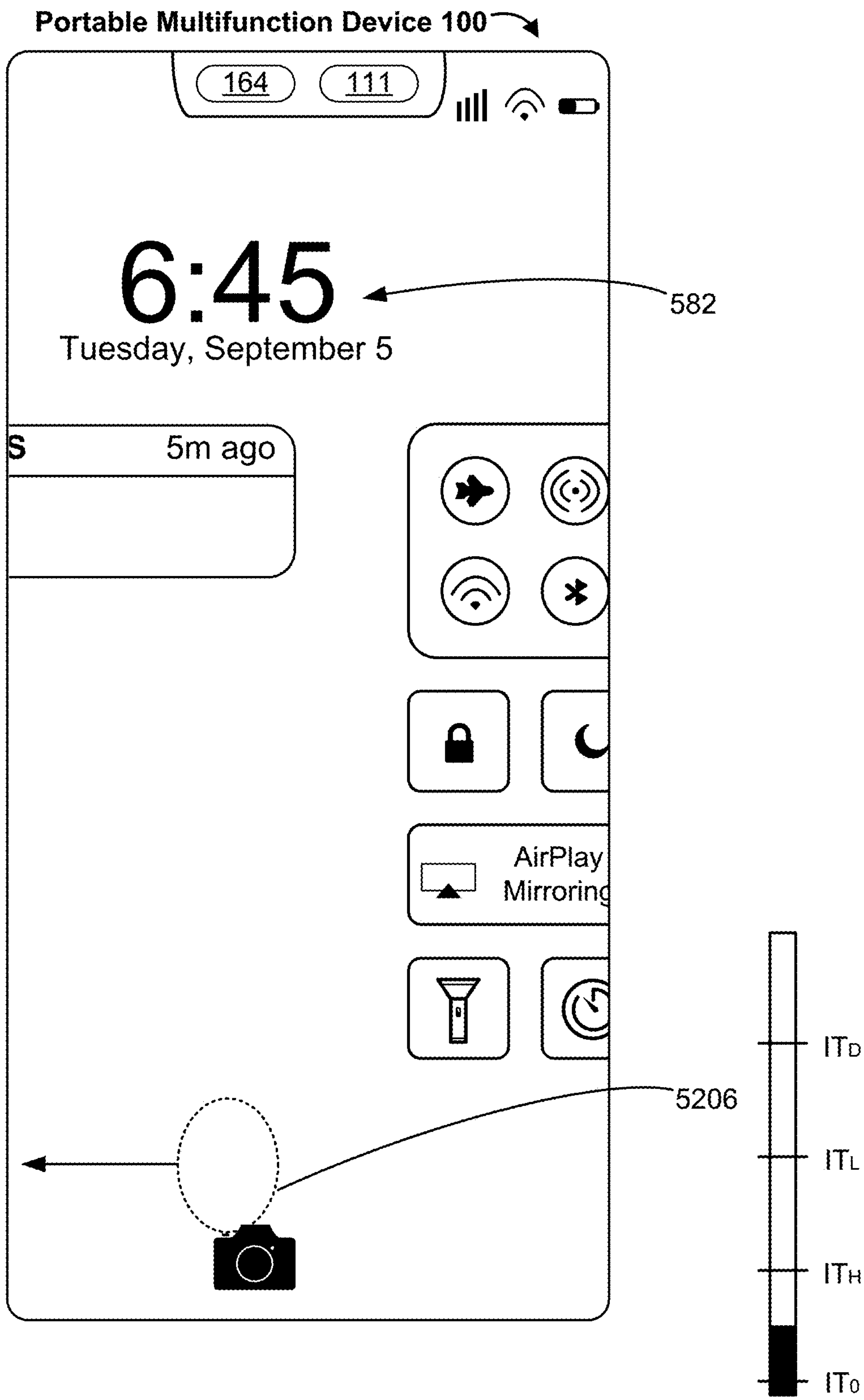
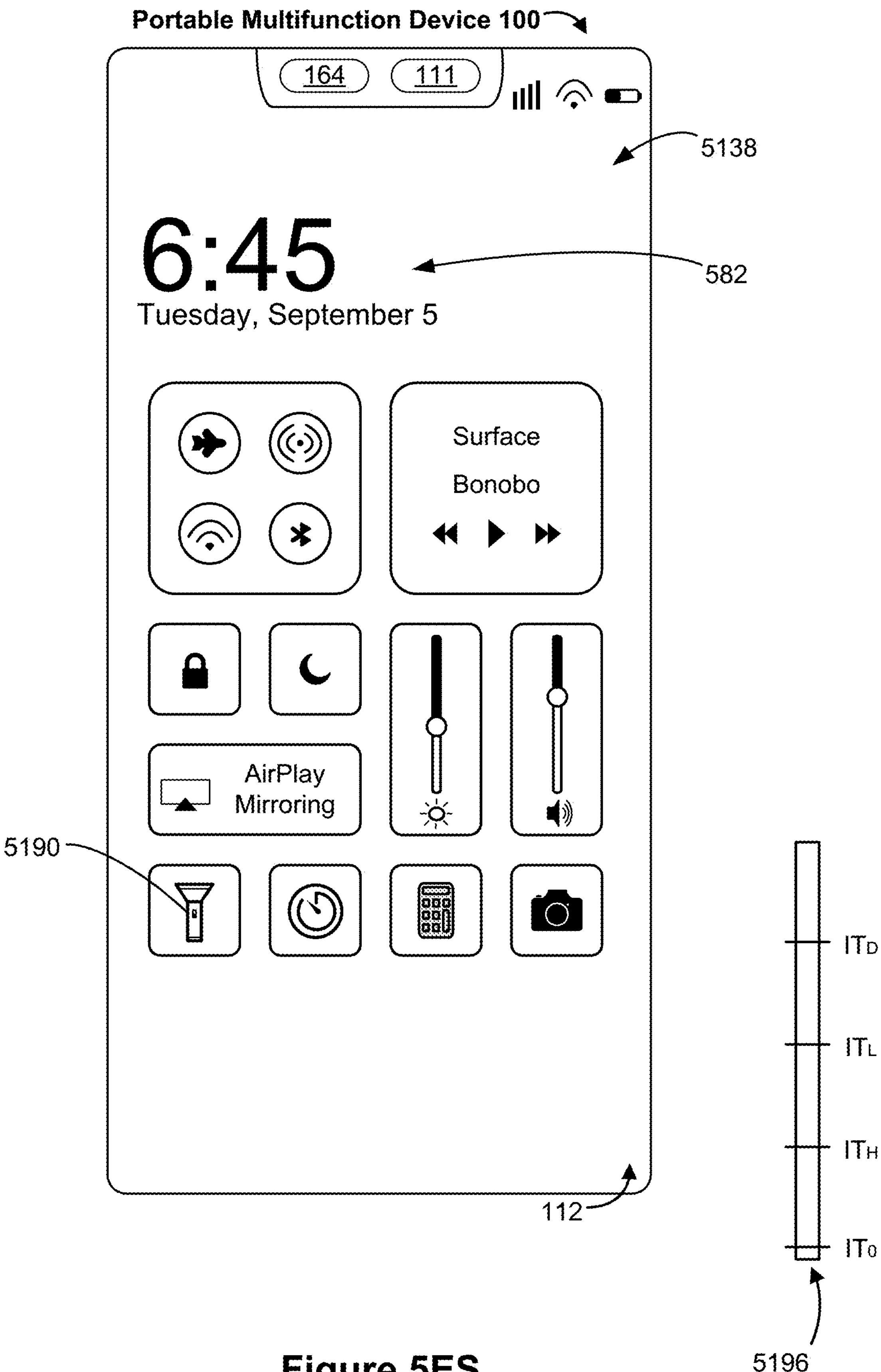

Portable Multifunction Device 100
164
111
6:45
Tuesday, September 5
582
MESSAGES
5m ago
Octavia
5206
ITD
ITL
ITH
IT0
112
5196

Figure 5EQ



Portable Multifunction Device 100
164
111
6:45
Tuesday, September 5
582
S
5m ago
AirPlay
Mirroring
5206
IT_D
IT_L
IT_H
IT_0

Figure 5ER



Portable Multifunction Device 100
164
111
5138
6:45
Tuesday, September 5
582
Surface
Bonobo
AirPlay
Mirroring
5190
112
ITD
ITL
ITH
IT0
5196

Figure 5ES

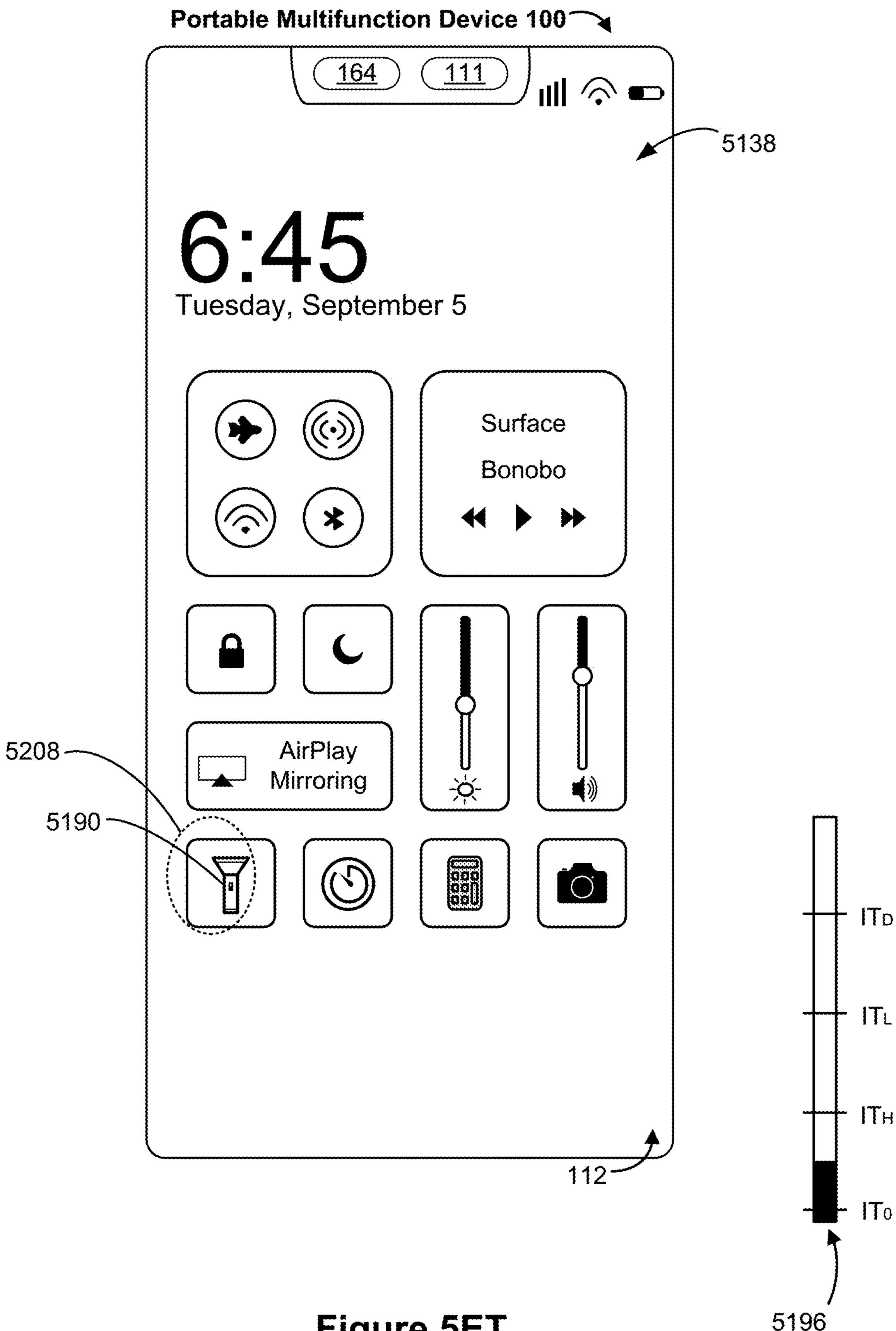

Portable Multifunction Device 100
164
111
5138
6:45
Tuesday, September 5
Surface
Bonobo
AirPlay
Mirroring
5208
5190
112
ITD
ITL
ITH
IT0
5196

Figure 5ET

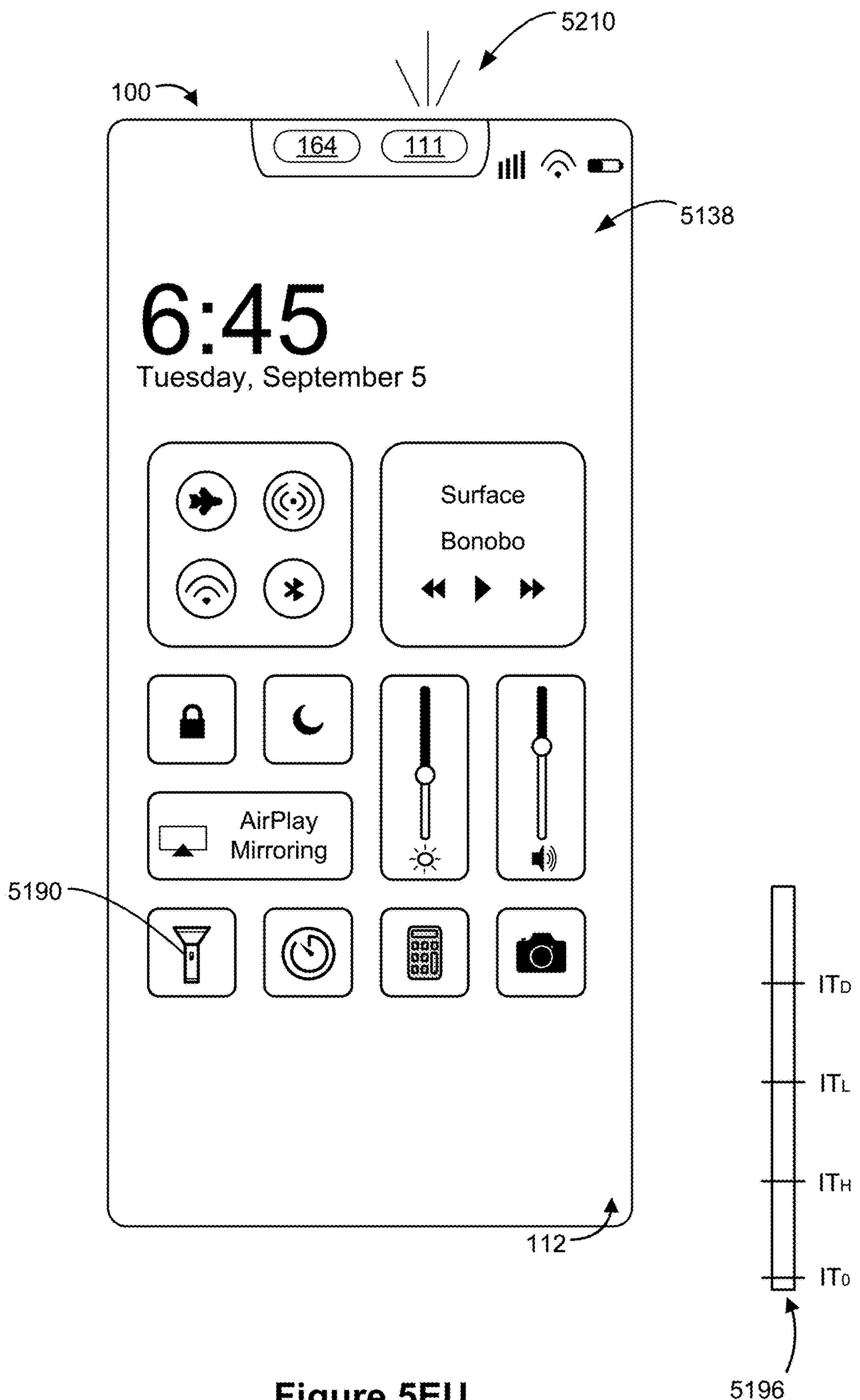

5210
100
164
111
5138
6:45
Tuesday, September 5
Surface
Bonobo
AirPlay
Mirroring
5190
ITD
ITL
ITH
IT0
112
5196

Figure 5EU

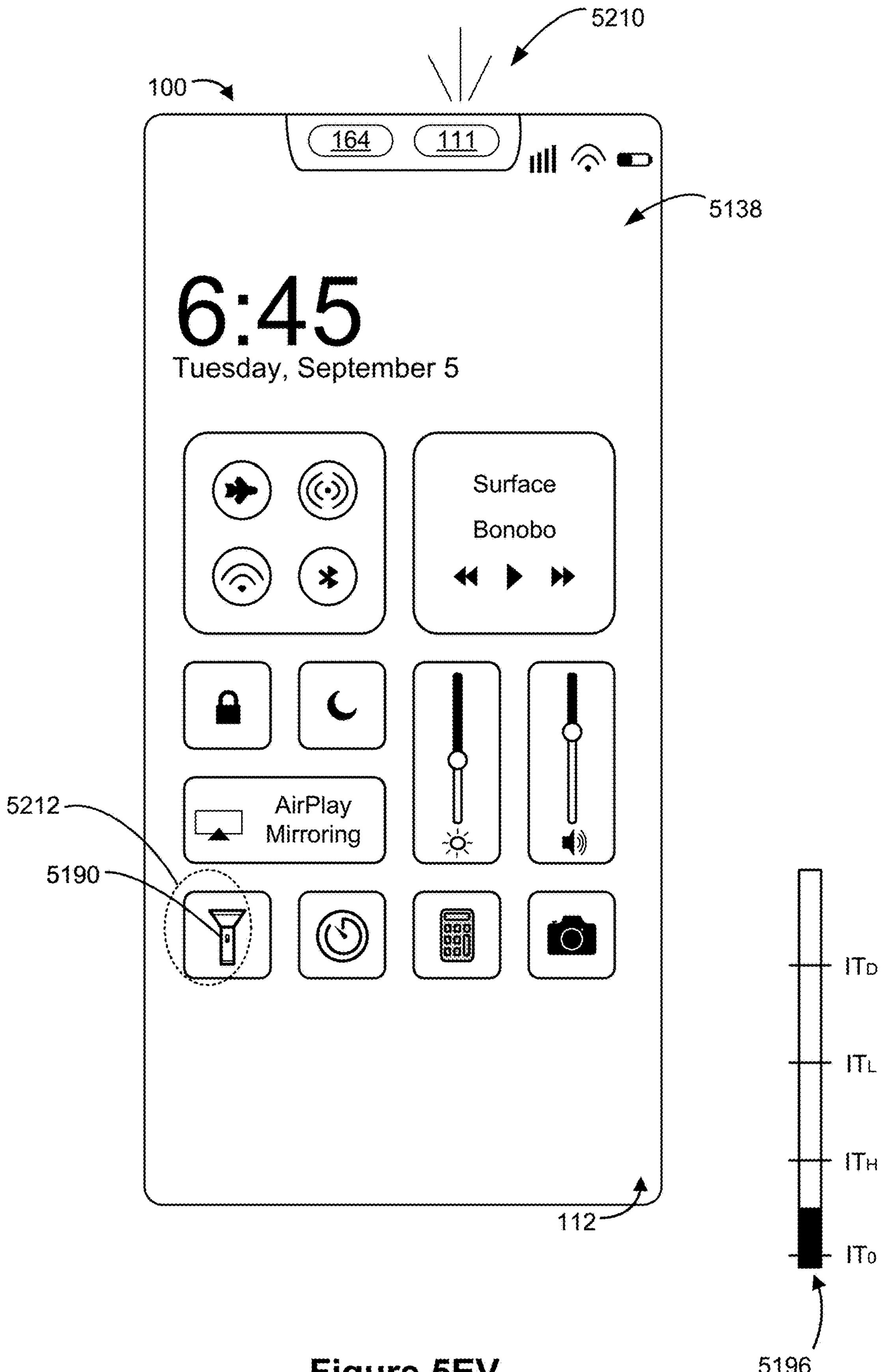
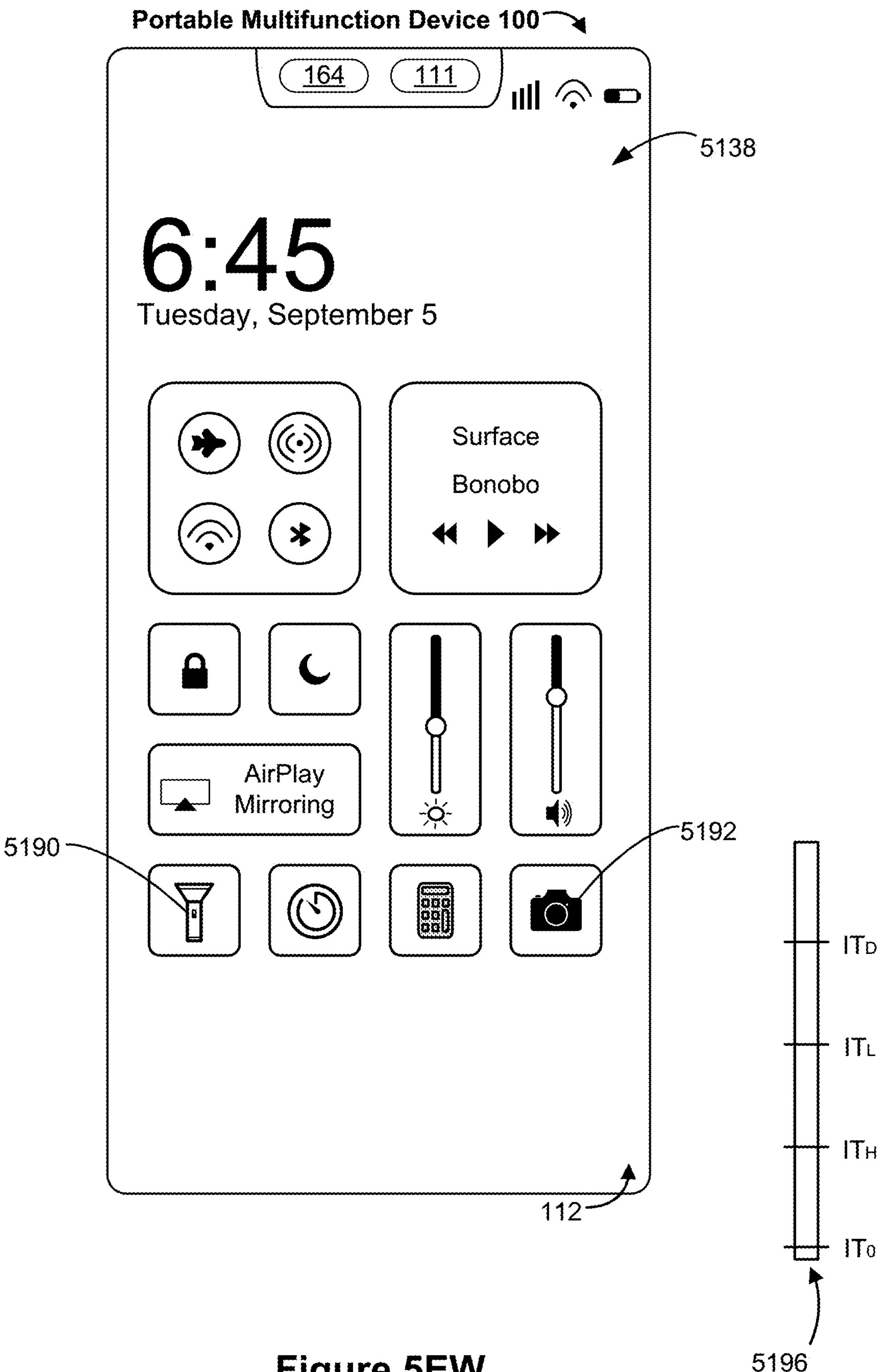
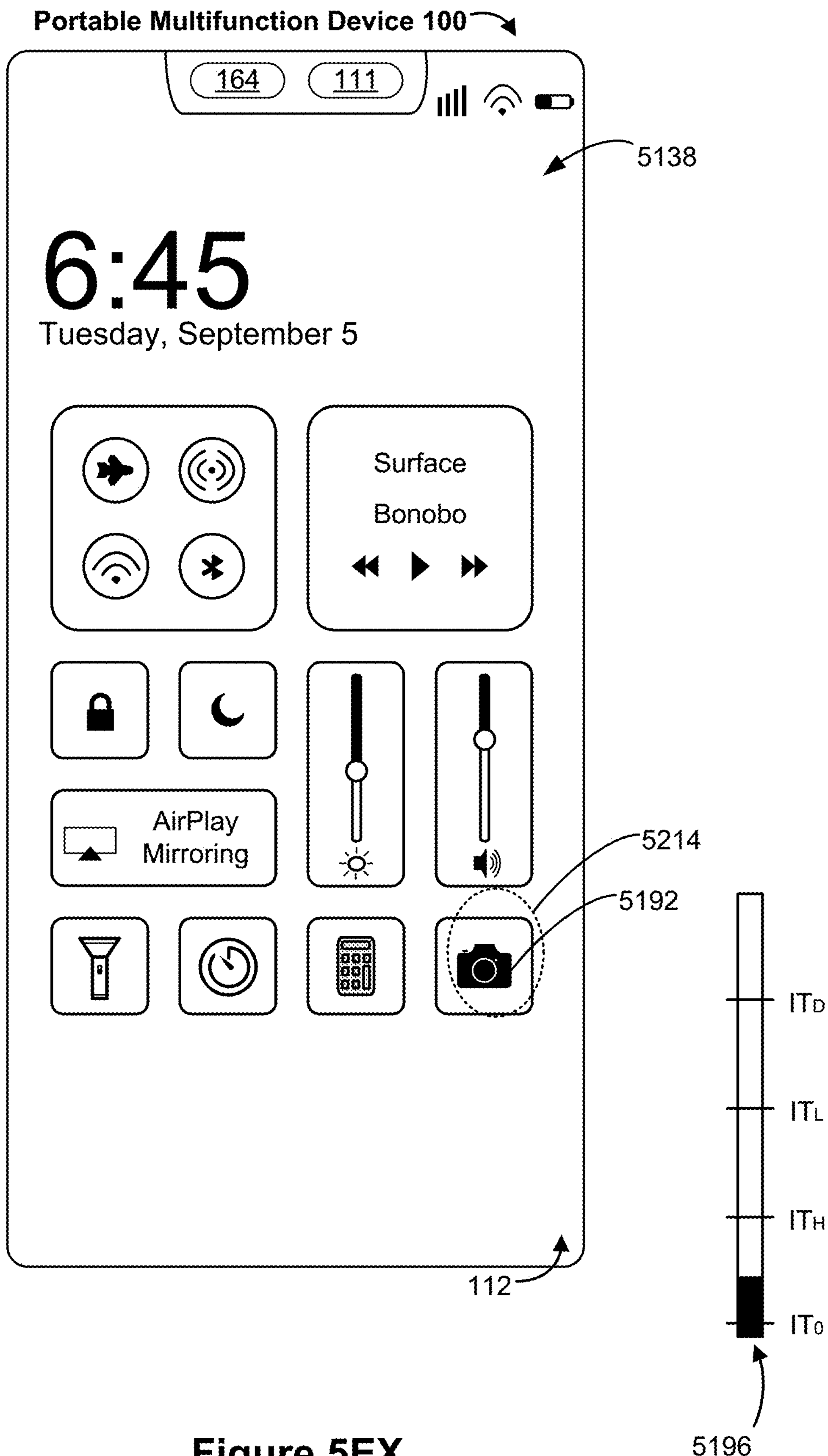

5210
100
164
111
5138
6:45
Tuesday, September 5
Surface
Bonobo
AirPlay
Mirroring
5212
5190
IT_D
IT_L
IT_H
IT_0
112
5196

Figure 5EV



Portable Multifunction Device 100
164
111
5138
6:45
Tuesday, September 5
Surface
Bonobo
AirPlay
Mirroring
5190
5192
112
ITD
ITL
ITH
IT0
5196

Figure 5EW



Portable Multifunction Device 100
164
111
5138
6:45
Tuesday, September 5
Surface
Bonobo
AirPlay
Mirroring
5214
5192
112
ITD
ITL
ITH
IT0
5196

Figure 5EX

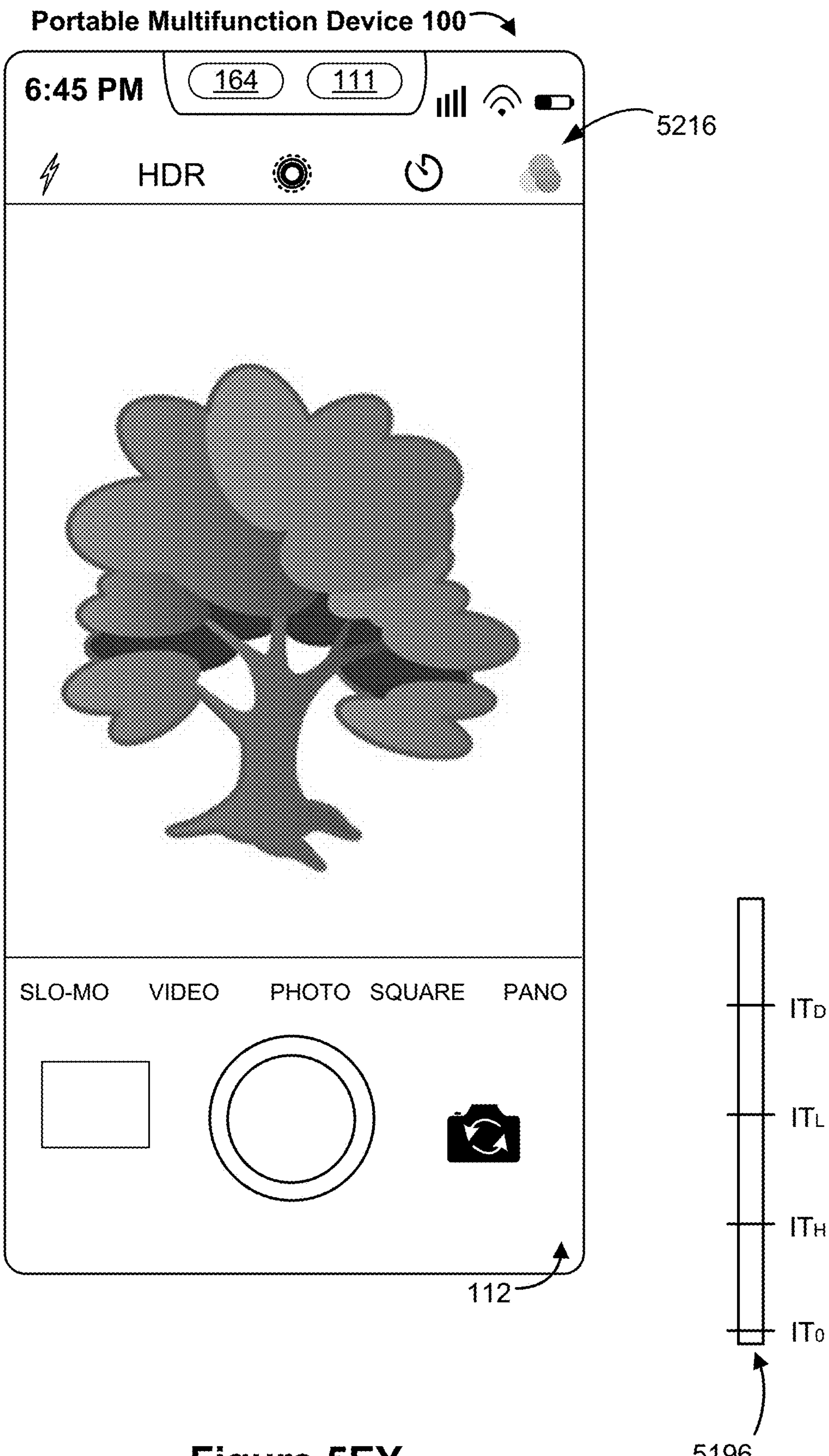
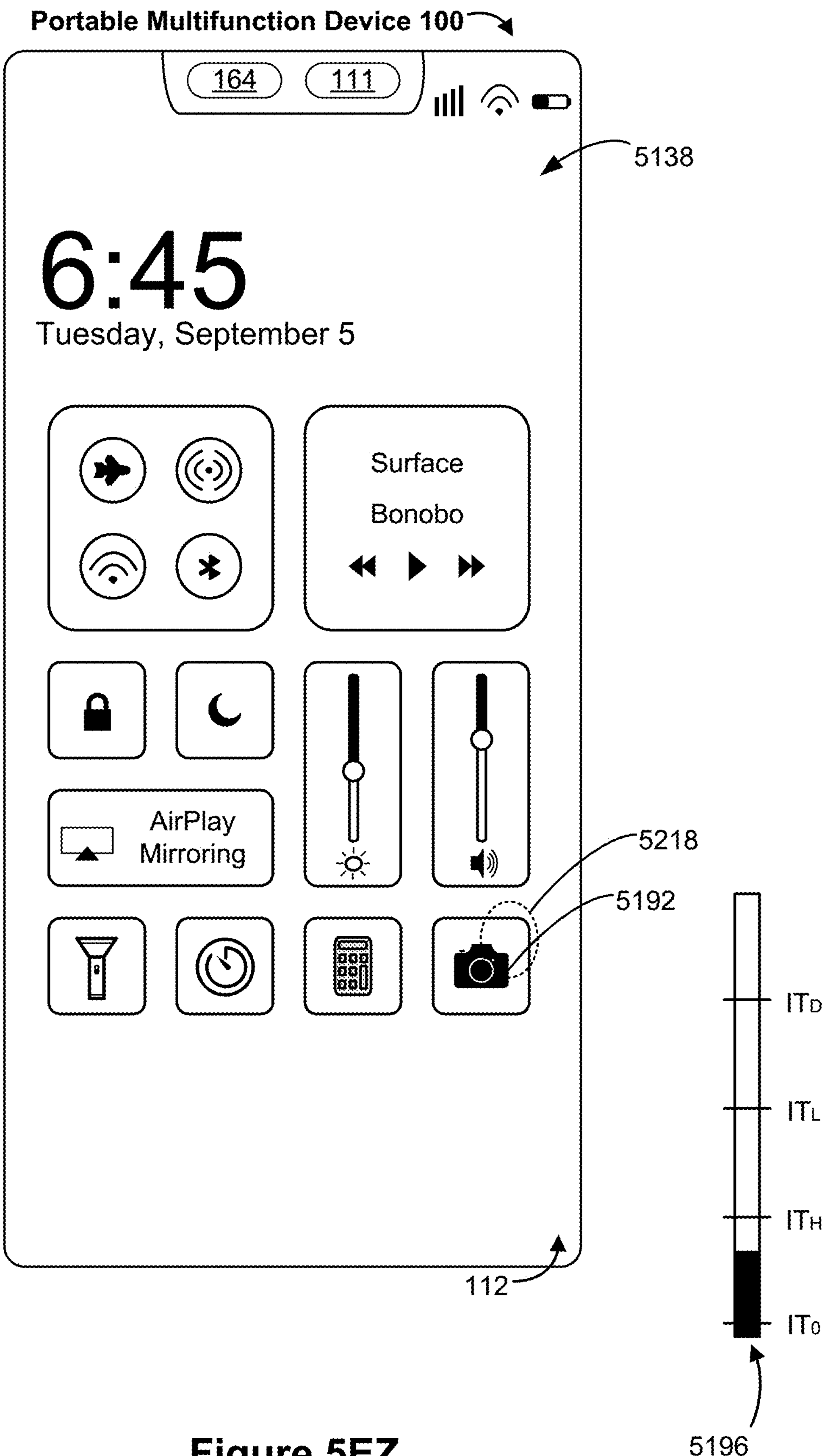

Portable Multifunction Device 100
6:45 PM
164
111
5216
HDR
SLO-MO
VIDEO
PHOTO
SQUARE
PANO
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5EY



Portable Multifunction Device 100
164
111
5138
6:45
Tuesday, September 5
Surface
Bonobo
AirPlay
Mirroring
5218
5192
IT_D
IT_L
IT_H
IT_0
112
5196

Figure 5EZ

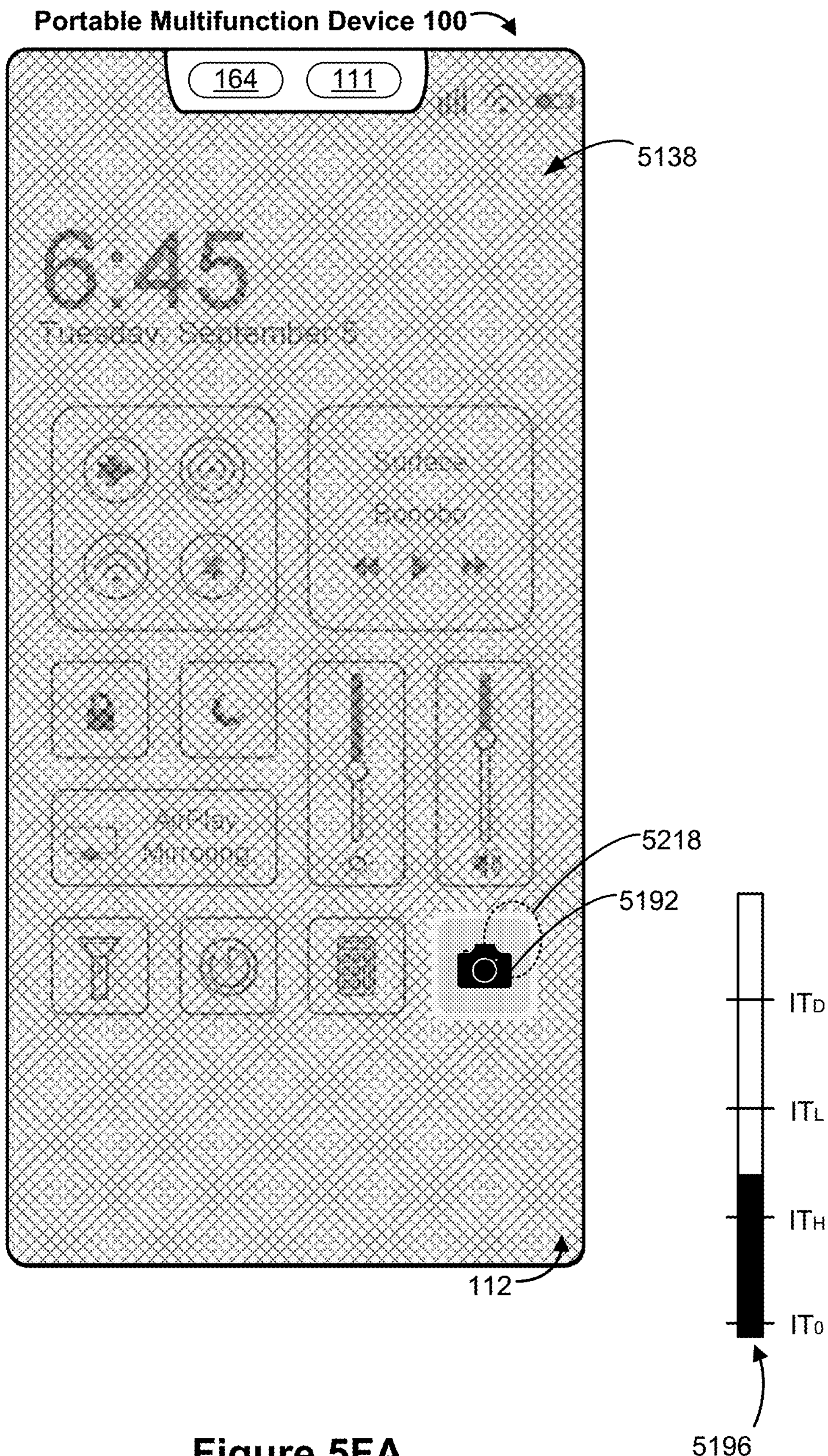

Portable Multifunction Device 100
164
111
5138
6:45
5218
5192
ITD
ITL
ITH
IT0
112
5196

Figure 5FA

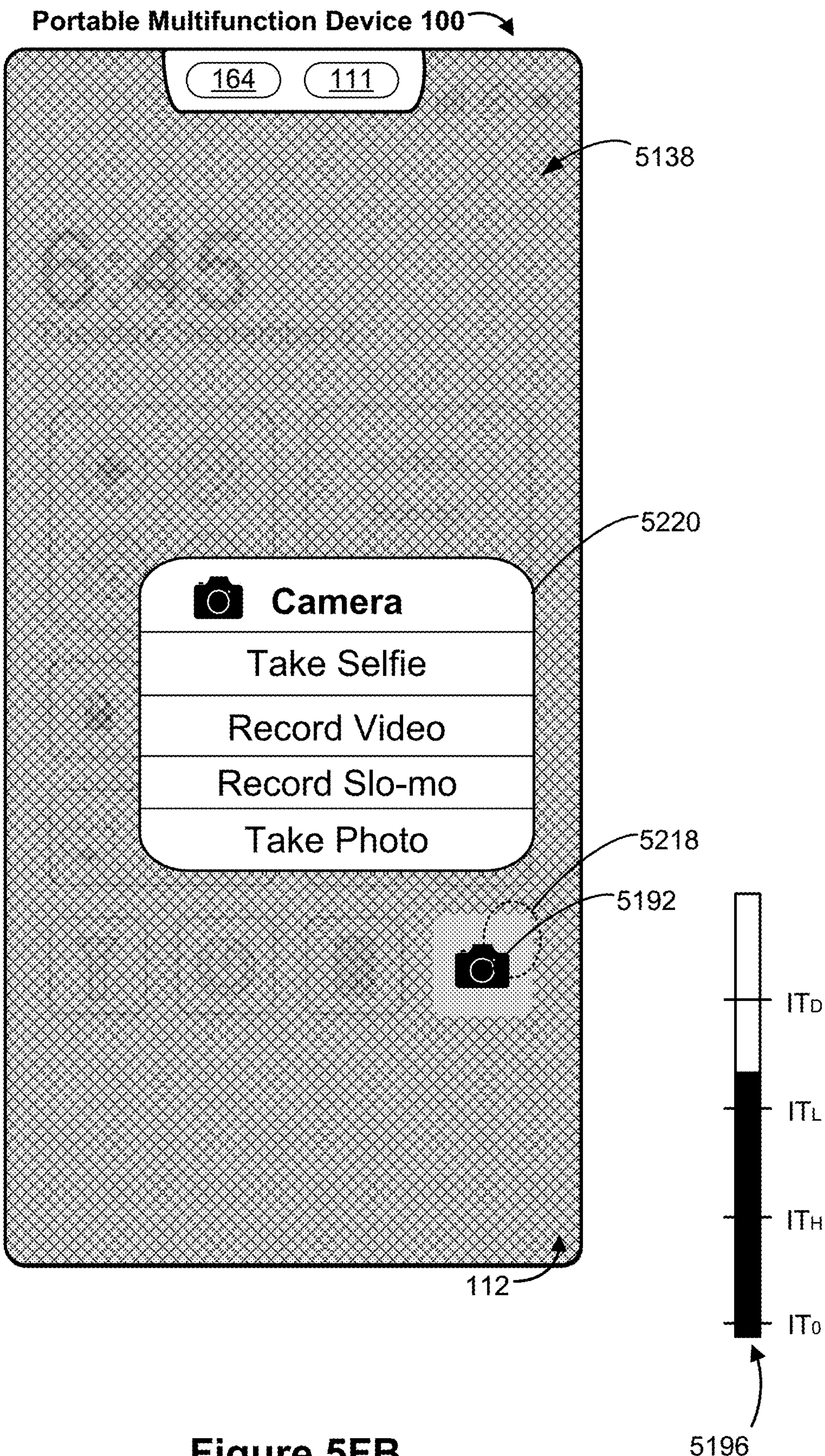

Portable Multifunction Device 100
164
111
5138
5220
Camera
Take Selfie
Record Video
Record Slo-mo
Take Photo
5218
5192
112
ITD
ITL
ITH
IT0
5196

Figure 5FB

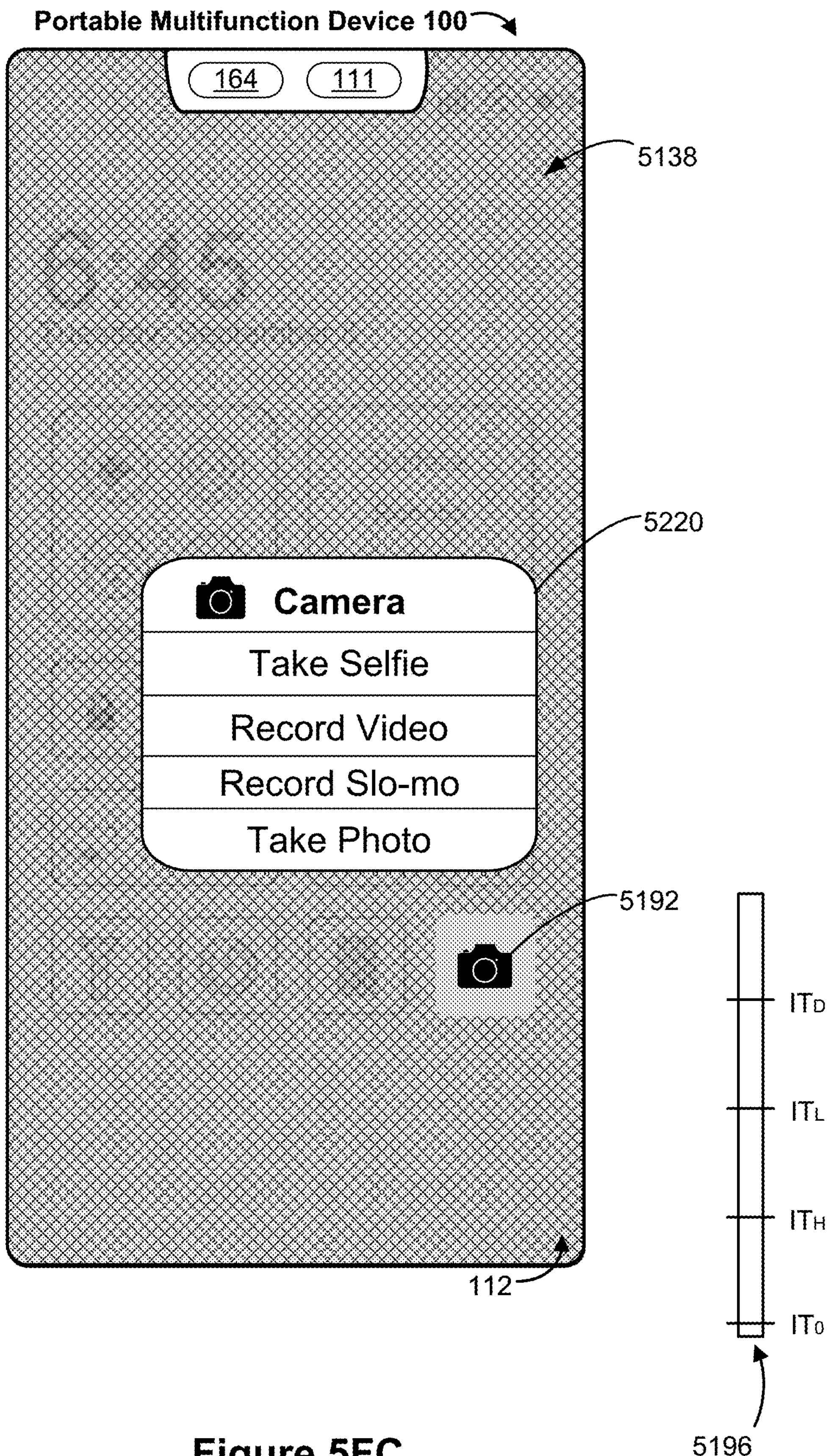

Portable Multifunction Device 100
164
111
5138
5220
Camera
Take Selfie
Record Video
Record Slo-mo
Take Photo
5192
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FC

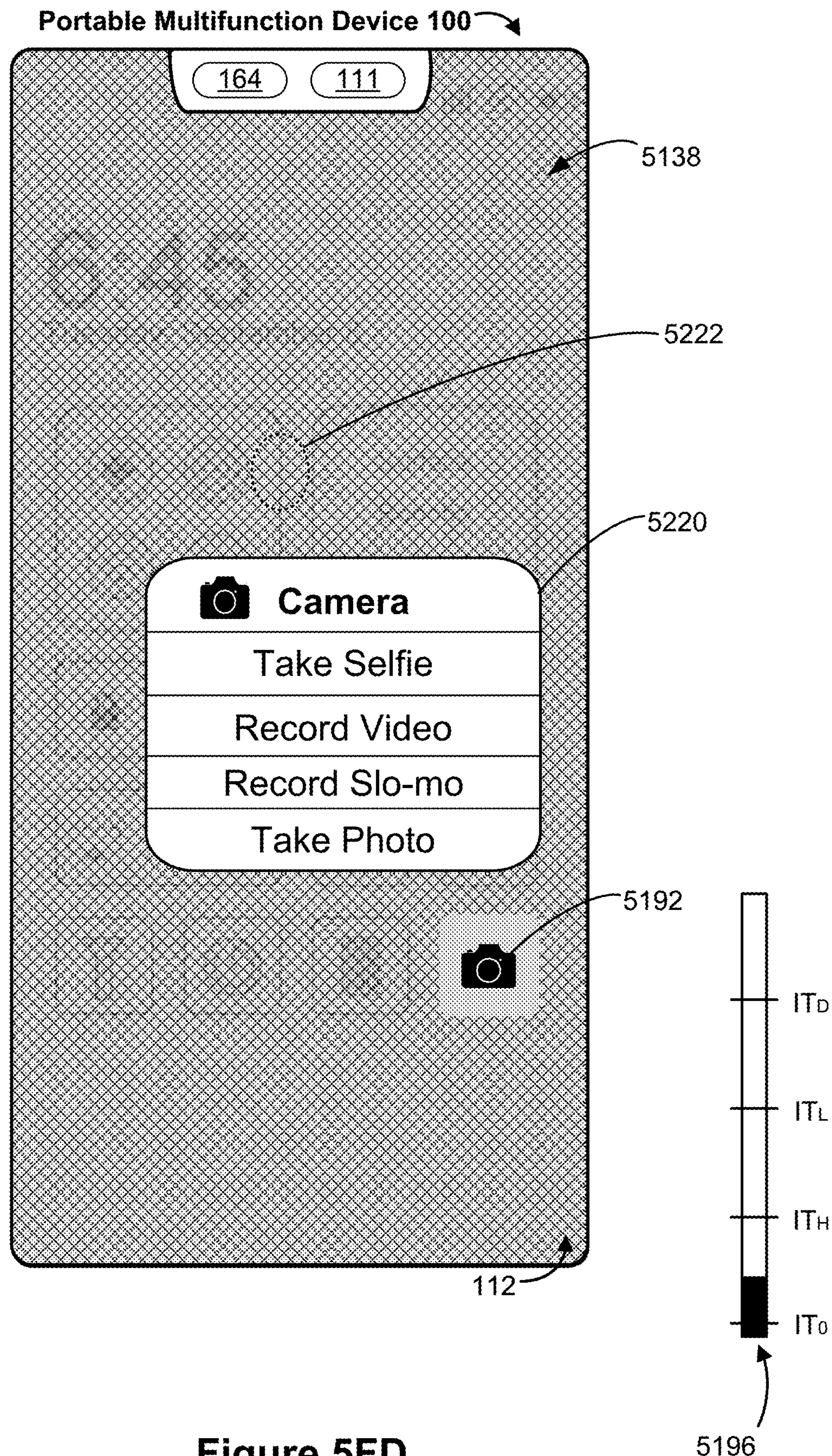
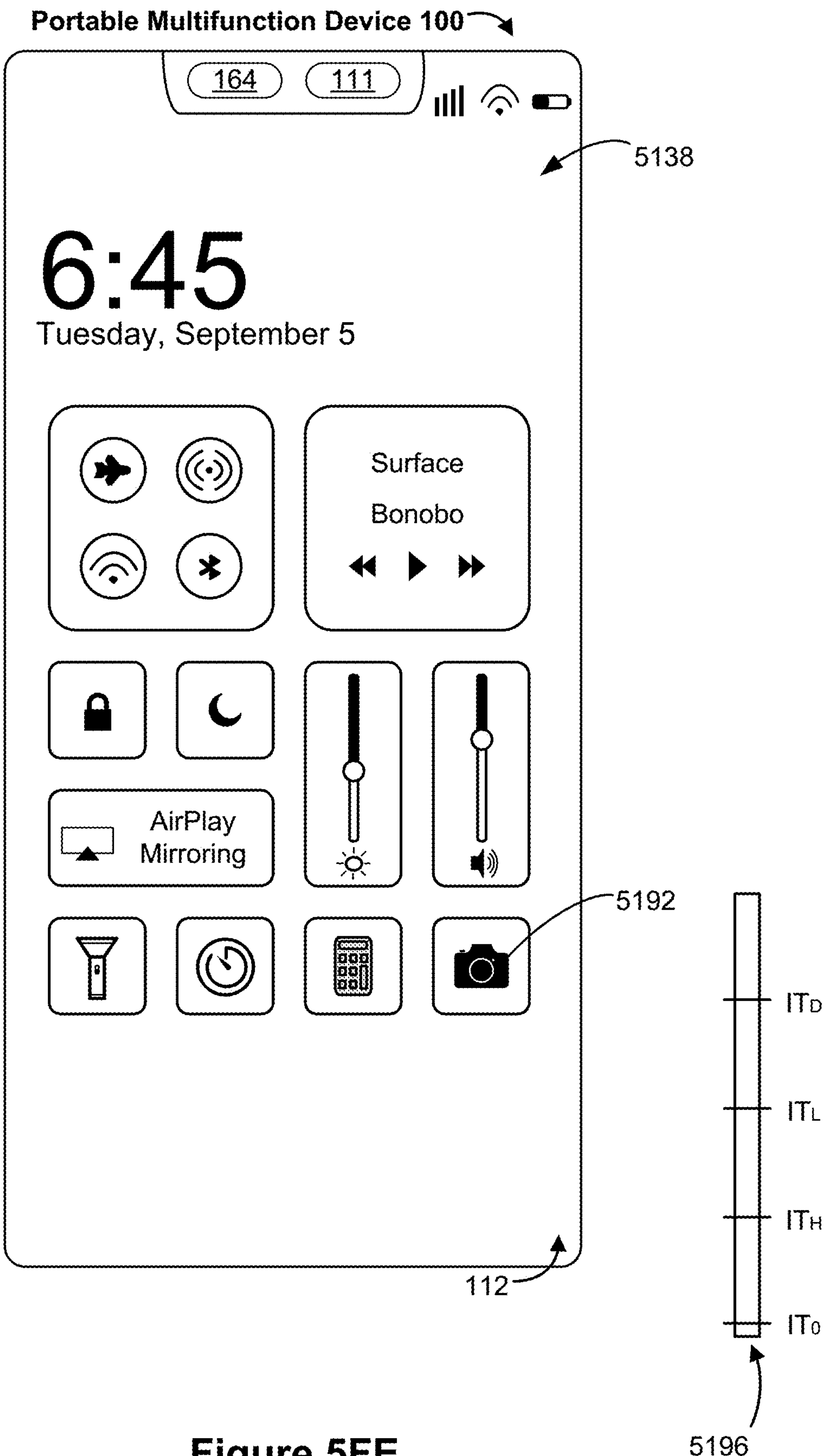
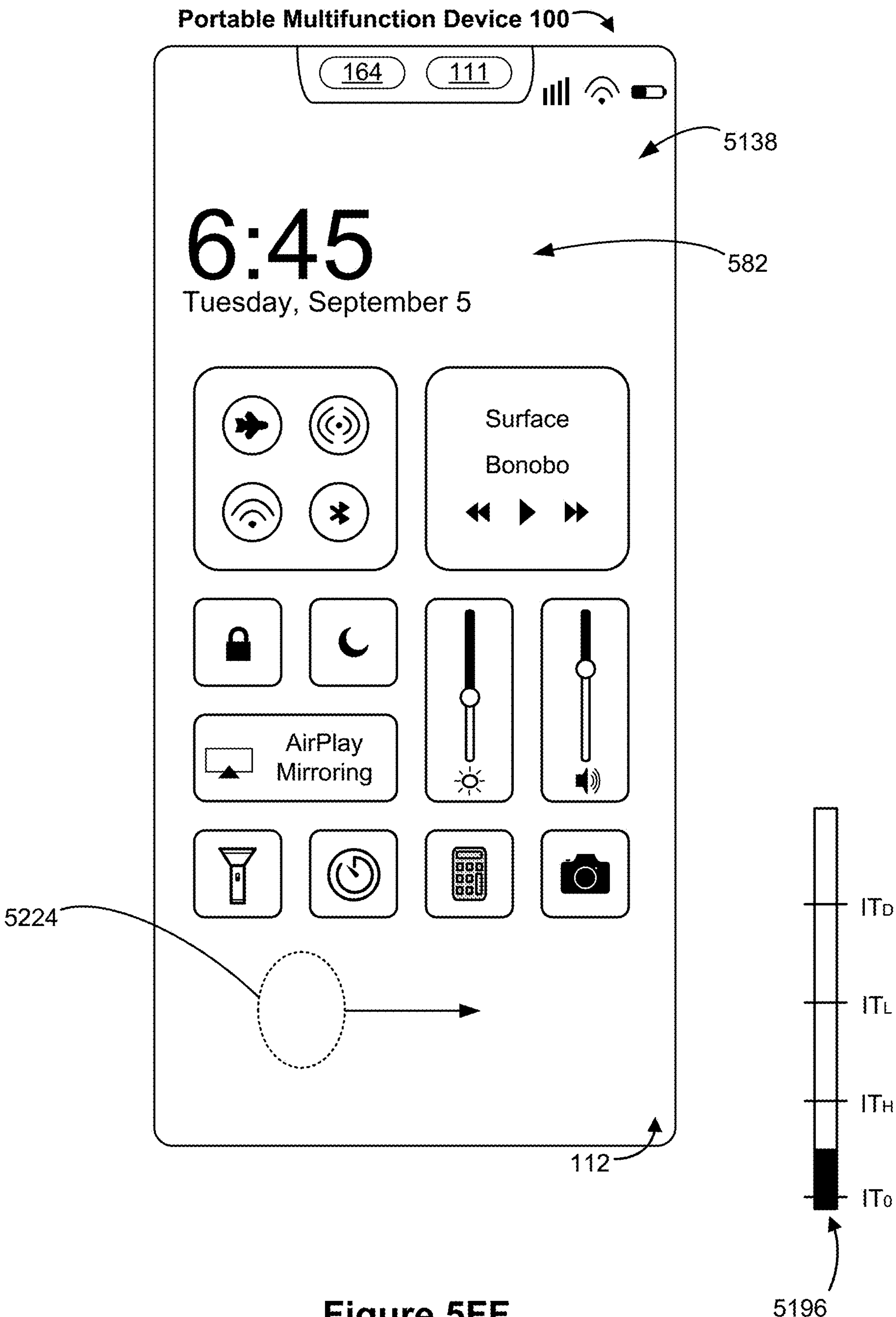

Portable Multifunction Device 100
164
111
5138
5222
5220
Camera
Take Selfie
Record Video
Record Slo-mo
Take Photo
5192
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FD



Portable Multifunction Device 100
164
111
5138
6:45
Tuesday, September 5
Surface
Bonobo
AirPlay
Mirroring
5192
ITD
ITL
ITH
IT0
112
5196

Figure 5FE



Portable Multifunction Device 100
164
111
5138
6:45
Tuesday, September 5
582
Surface
Bonobo
AirPlay
Mirroring
5224
112
ITD
ITL
ITH
IT0
5196

Figure 5FF

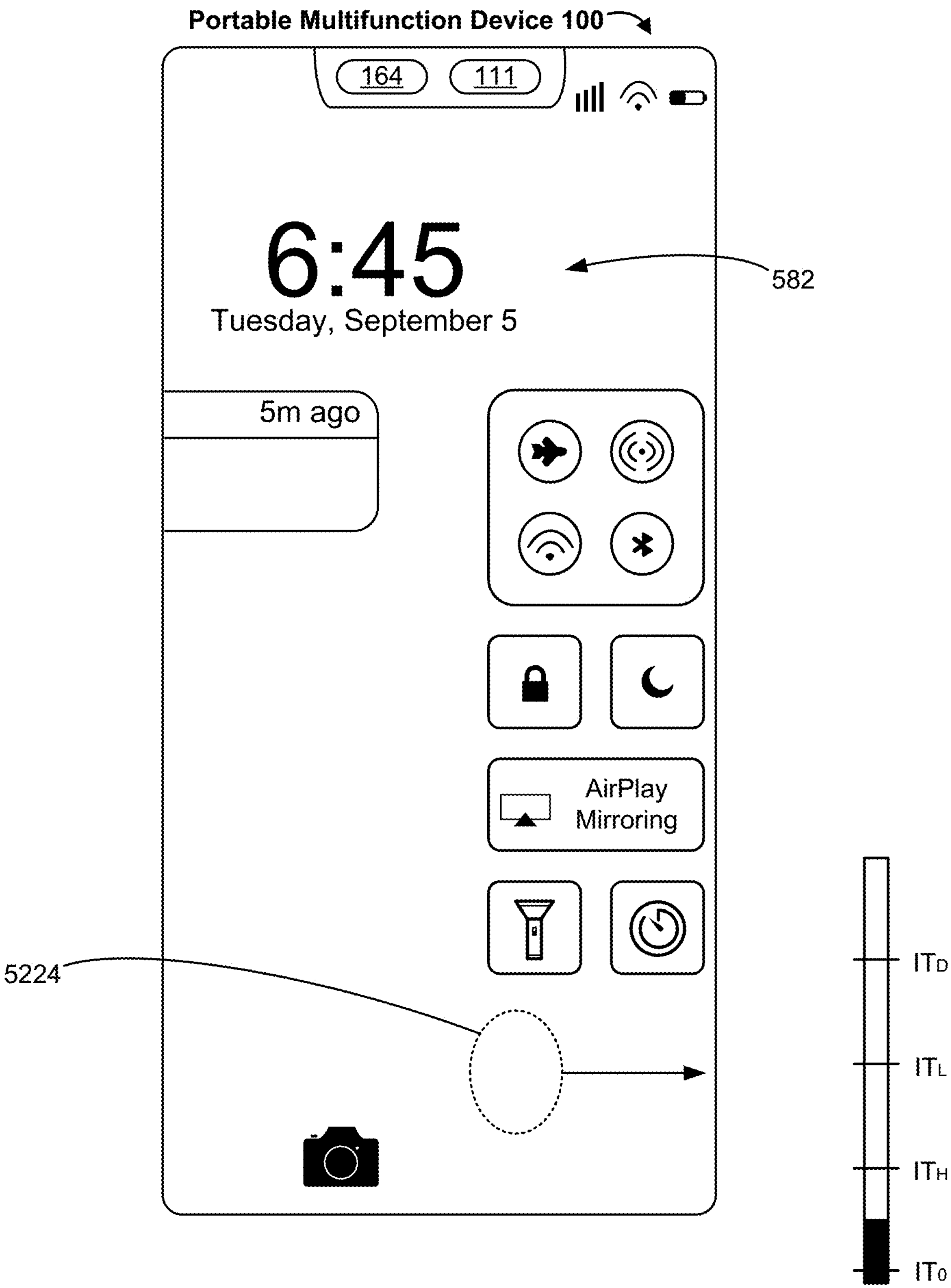
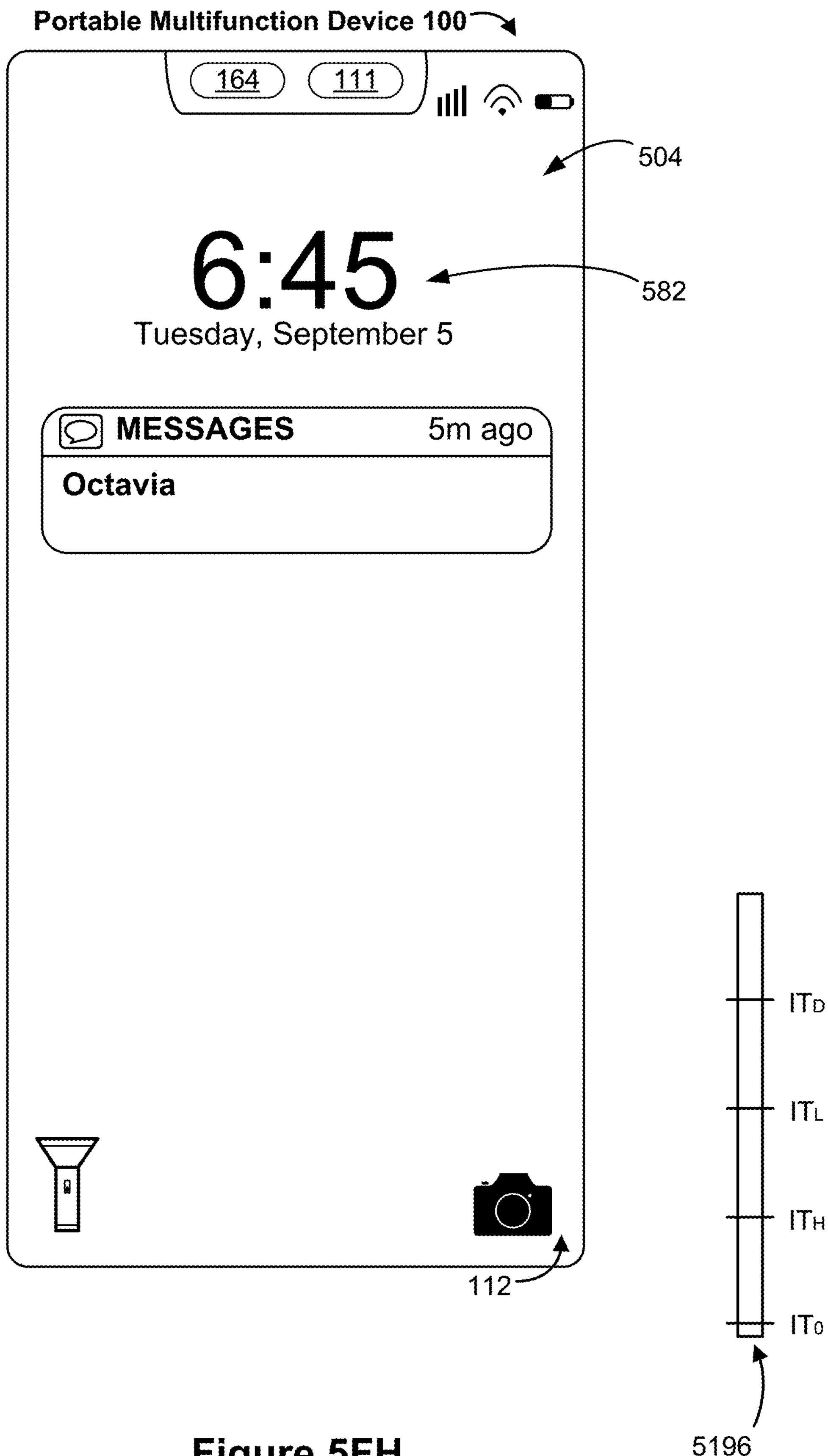
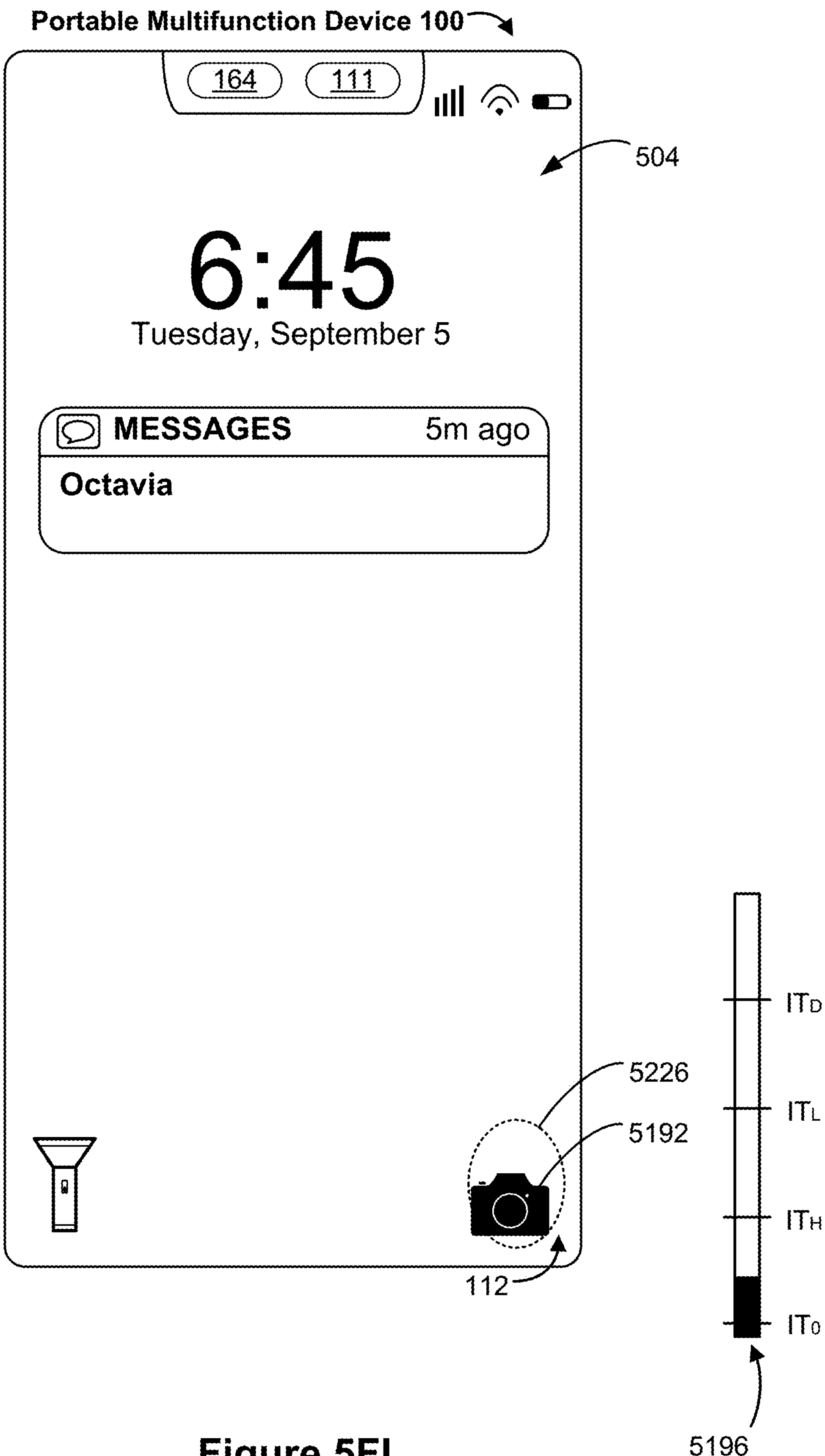

Portable Multifunction Device 100
164
111
6:45
Tuesday, September 5
582
5m ago
AirPlay Mirroring
5224
ITD
ITL
ITH
IT0

Figure 5FG



Portable Multifunction Device 100
164
111
504
6:45
582
Tuesday, September 5
MESSAGES
5m ago
Octavia
112
ITD
ITL
ITH
IT0
5196

Figure 5FH



Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5226
5192
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FI

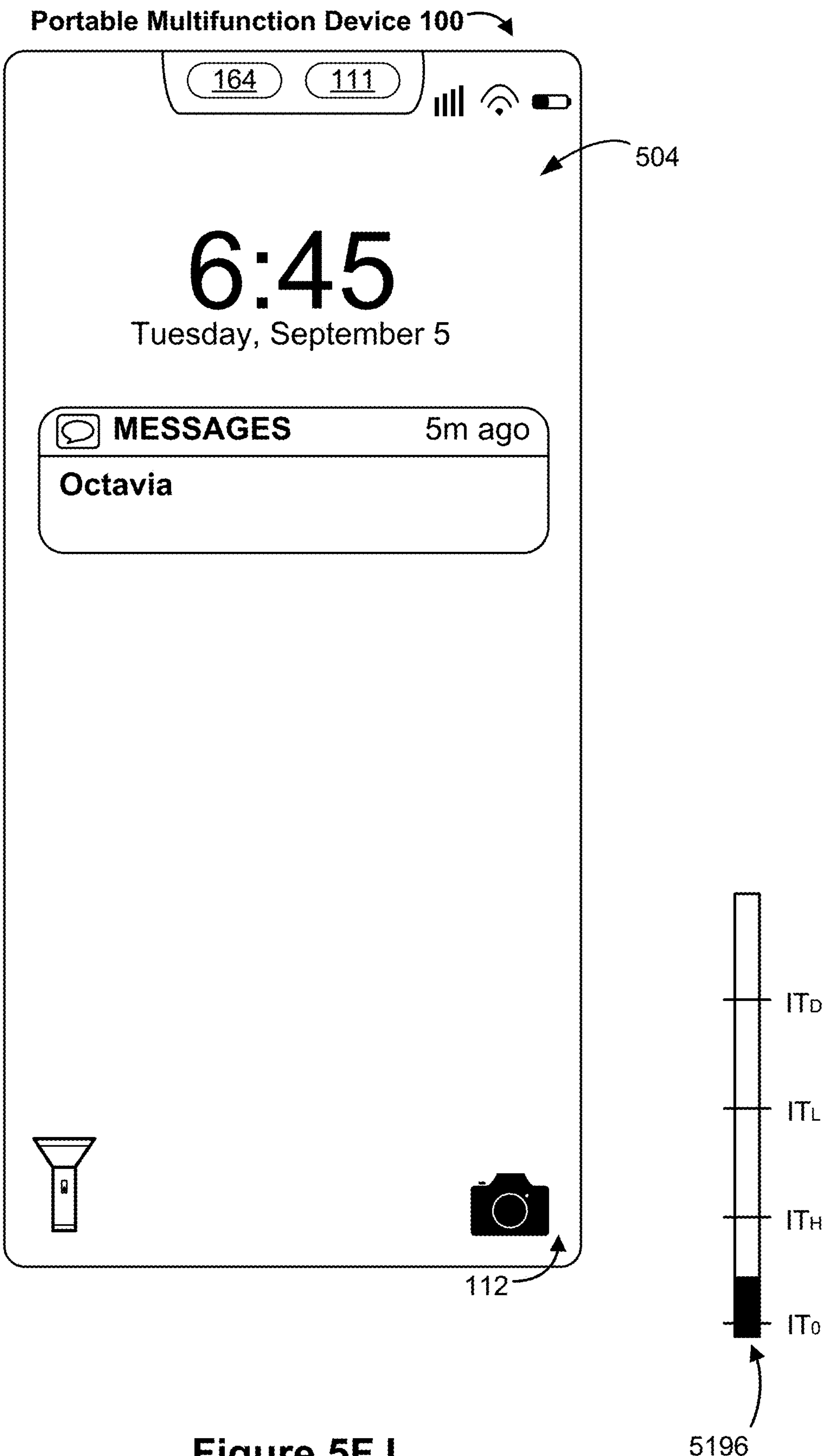

Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
112
ITD
ITL
ITH
IT0
5196

Figure 5FJ

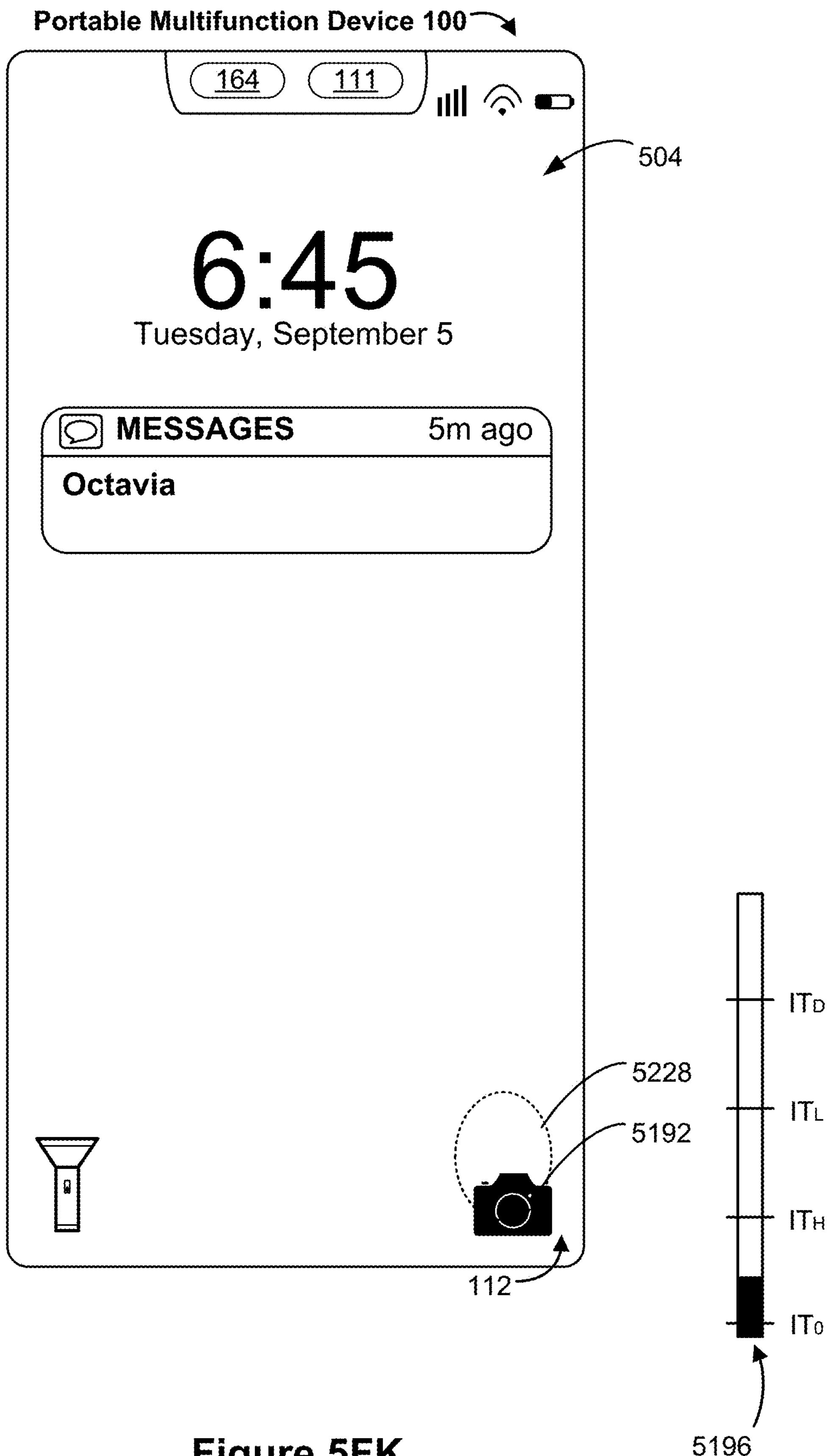
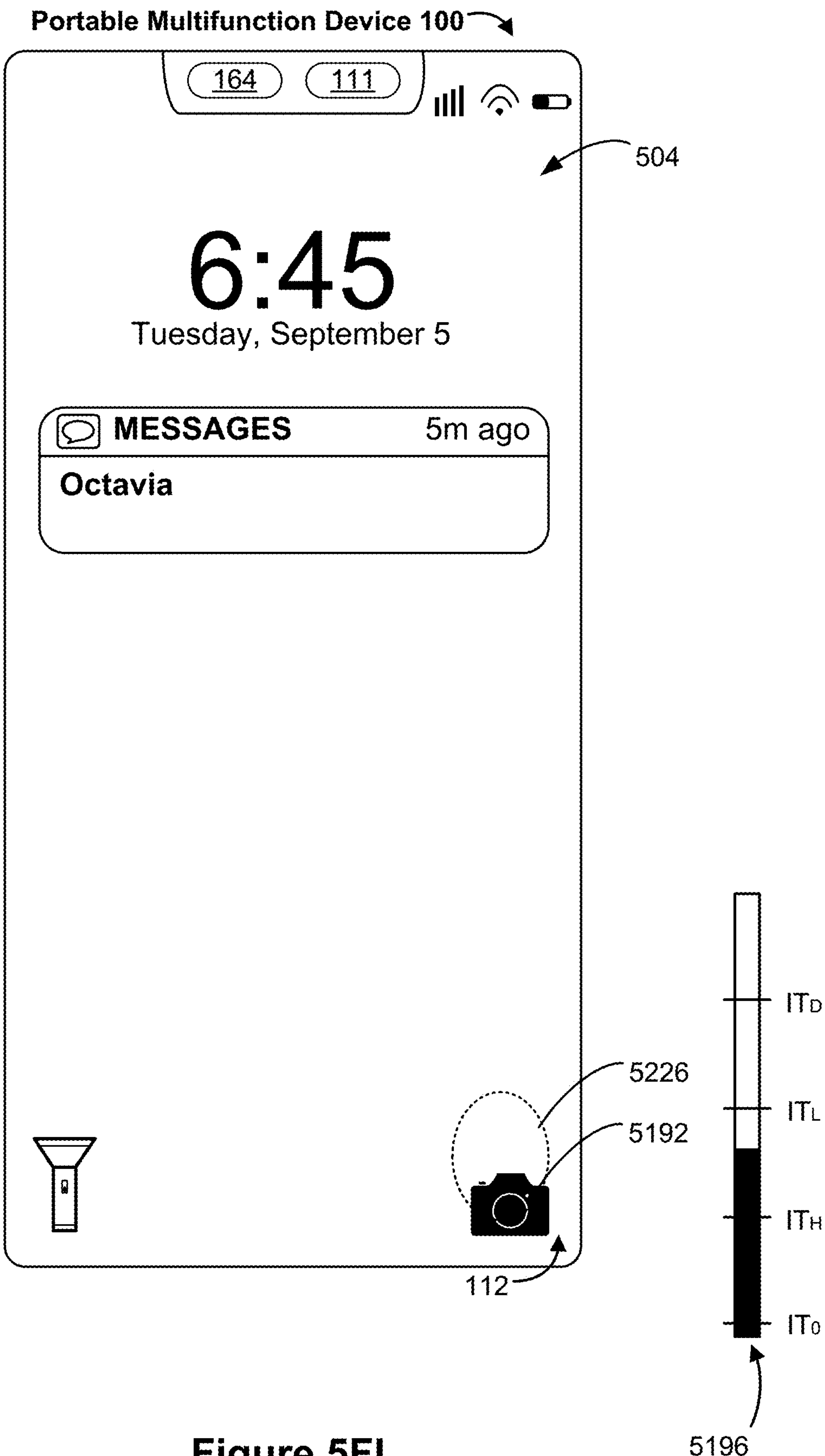
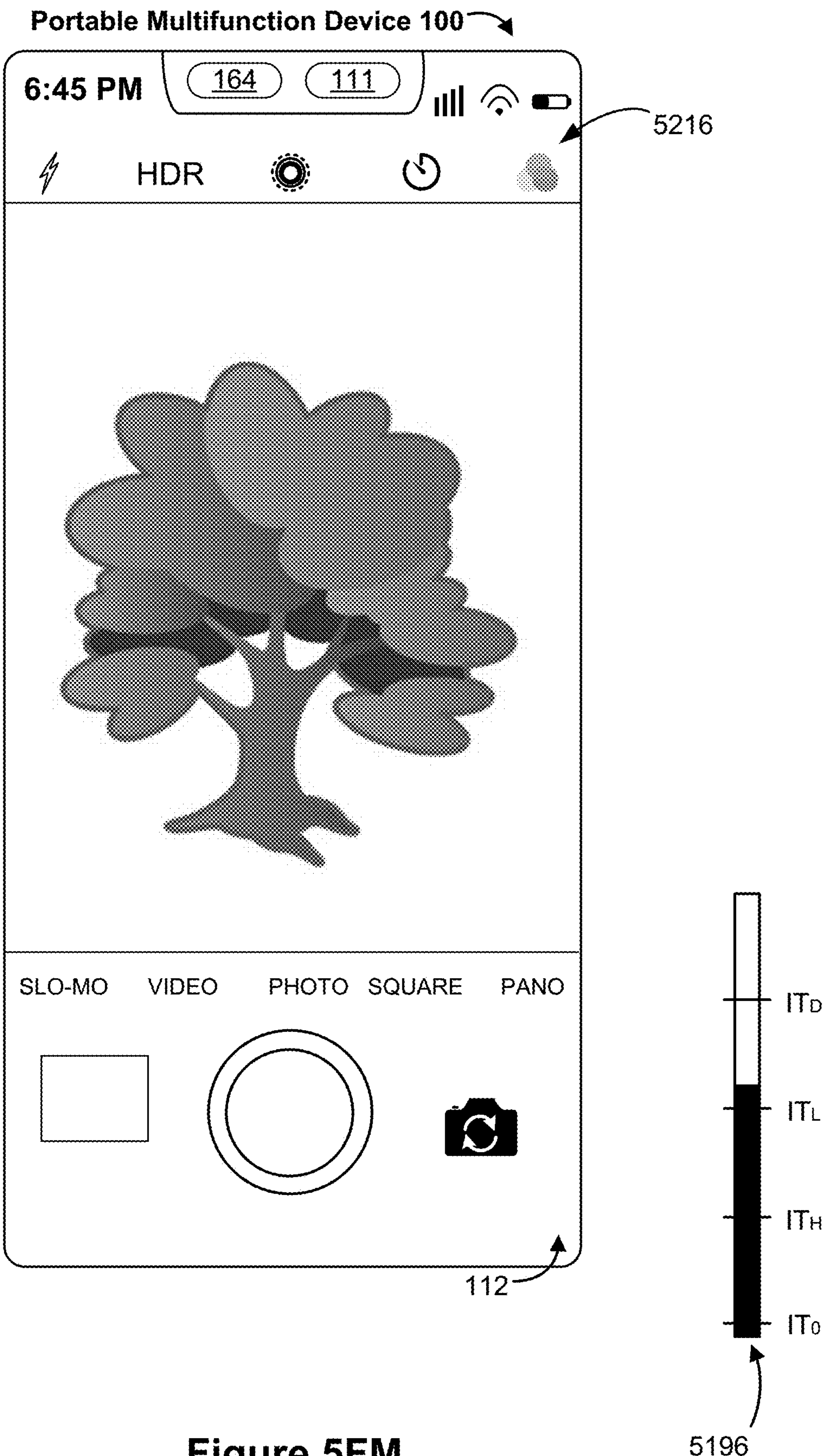

Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5228
5192
112
ITD
ITL
ITH
IT0
5196

Figure 5FK



Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5226
5192
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FL



Portable Multifunction Device 100
6:45 PM
164
111
5216
HDR
SLO-MO
VIDEO
PHOTO
SQUARE
PANO
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FM

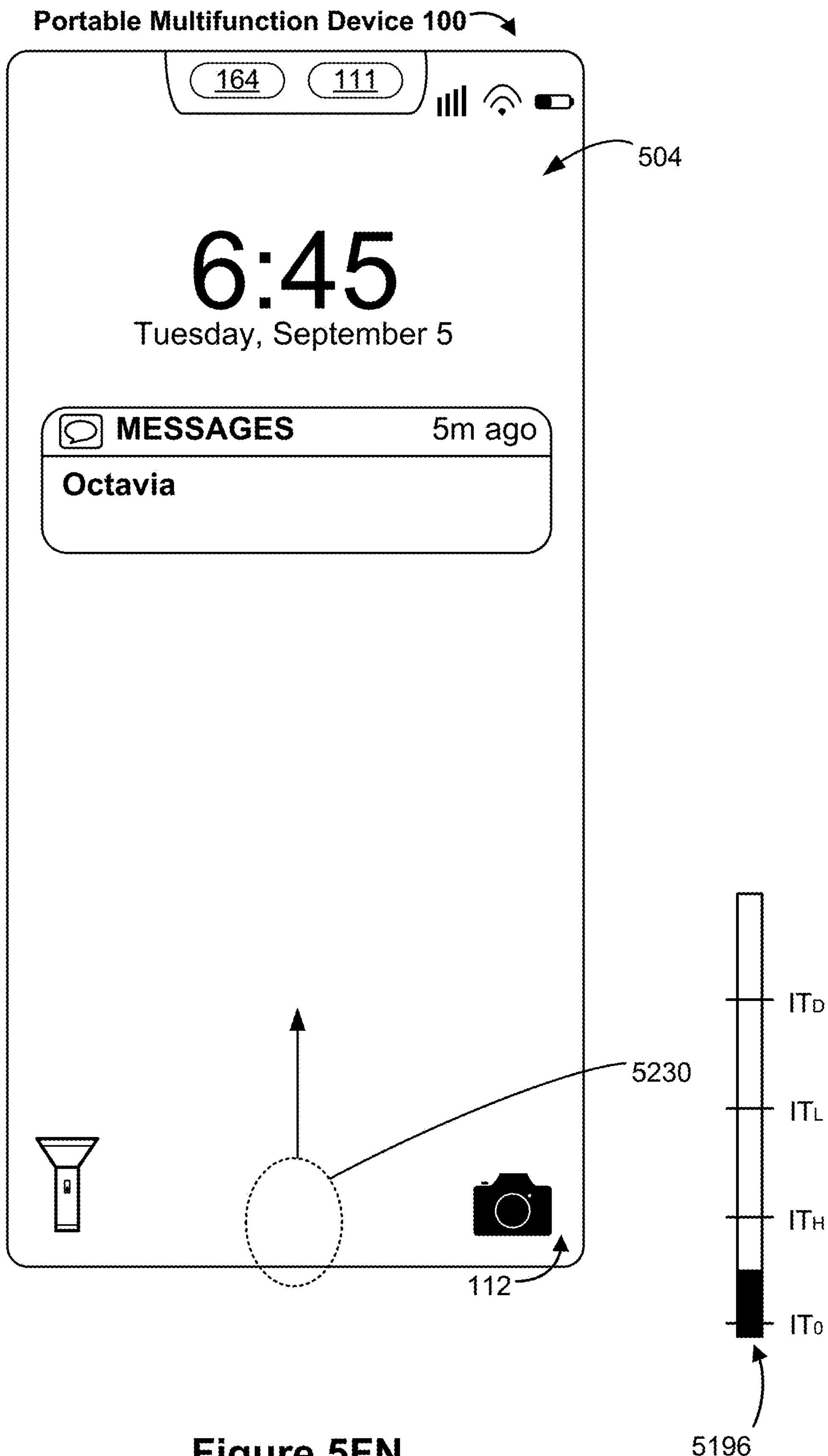
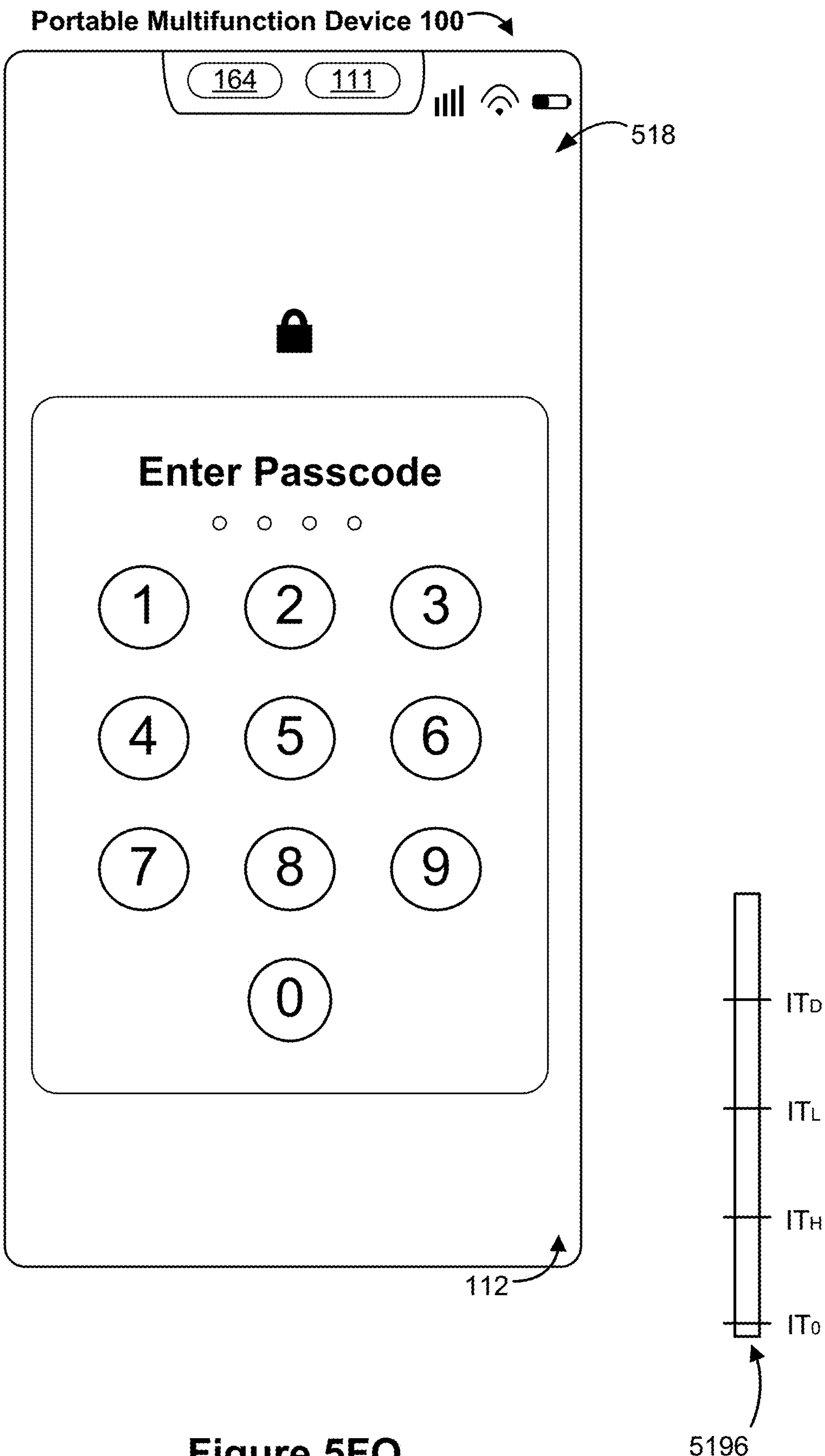
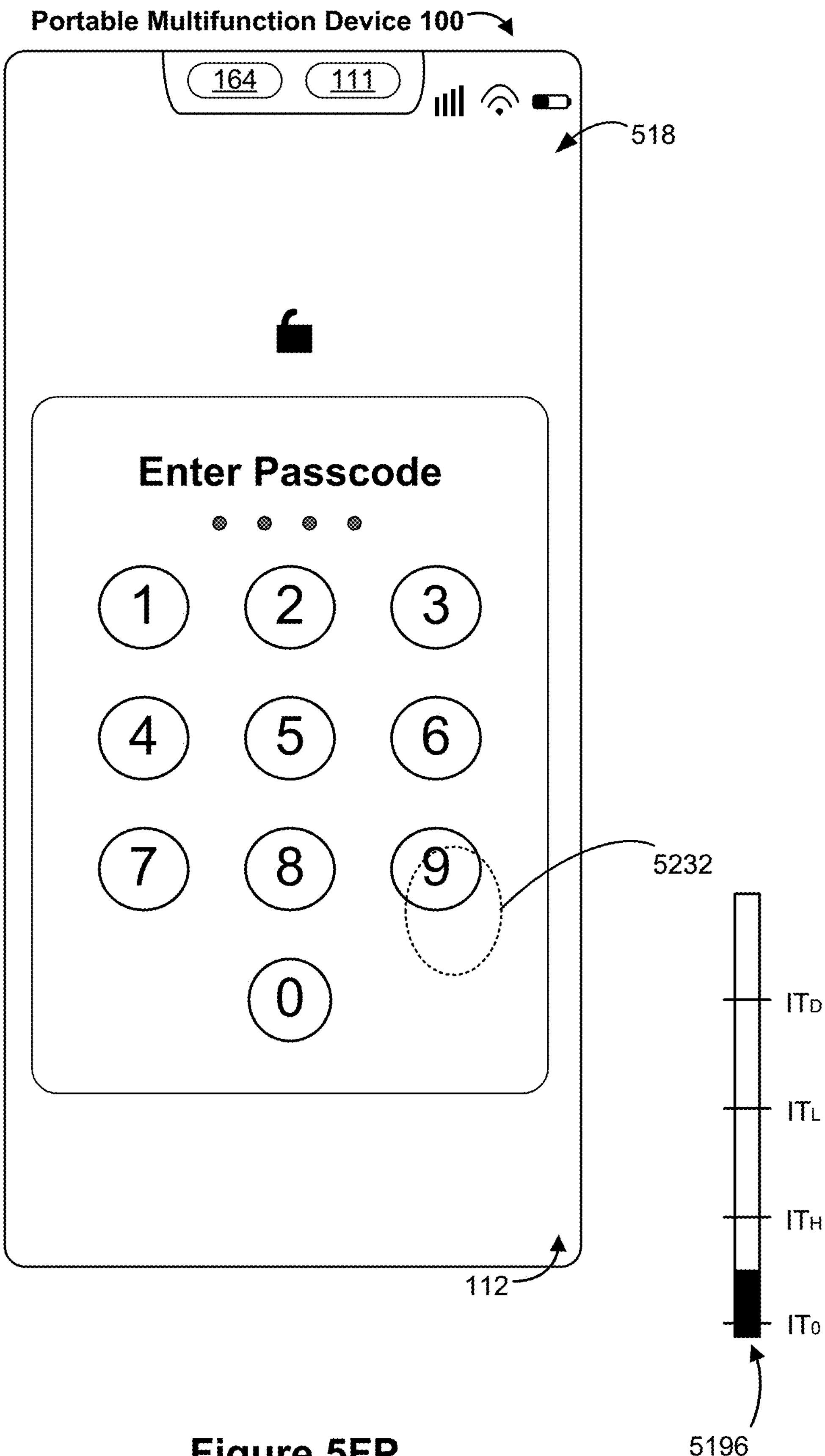

Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
5230
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FN



Portable Multifunction Device 100
164
111
518
Enter Passcode
1
2
3
4
5
6
7
8
9
0
112
ITD
ITL
ITH
IT0
5196

Figure 5FO



Portable Multifunction Device 100
164
111
518
Enter Passcode
1
2
3
4
5
6
7
8
9
0
5232
IT_D
IT_L
IT_H
IT_0
112
5196

Figure 5FP

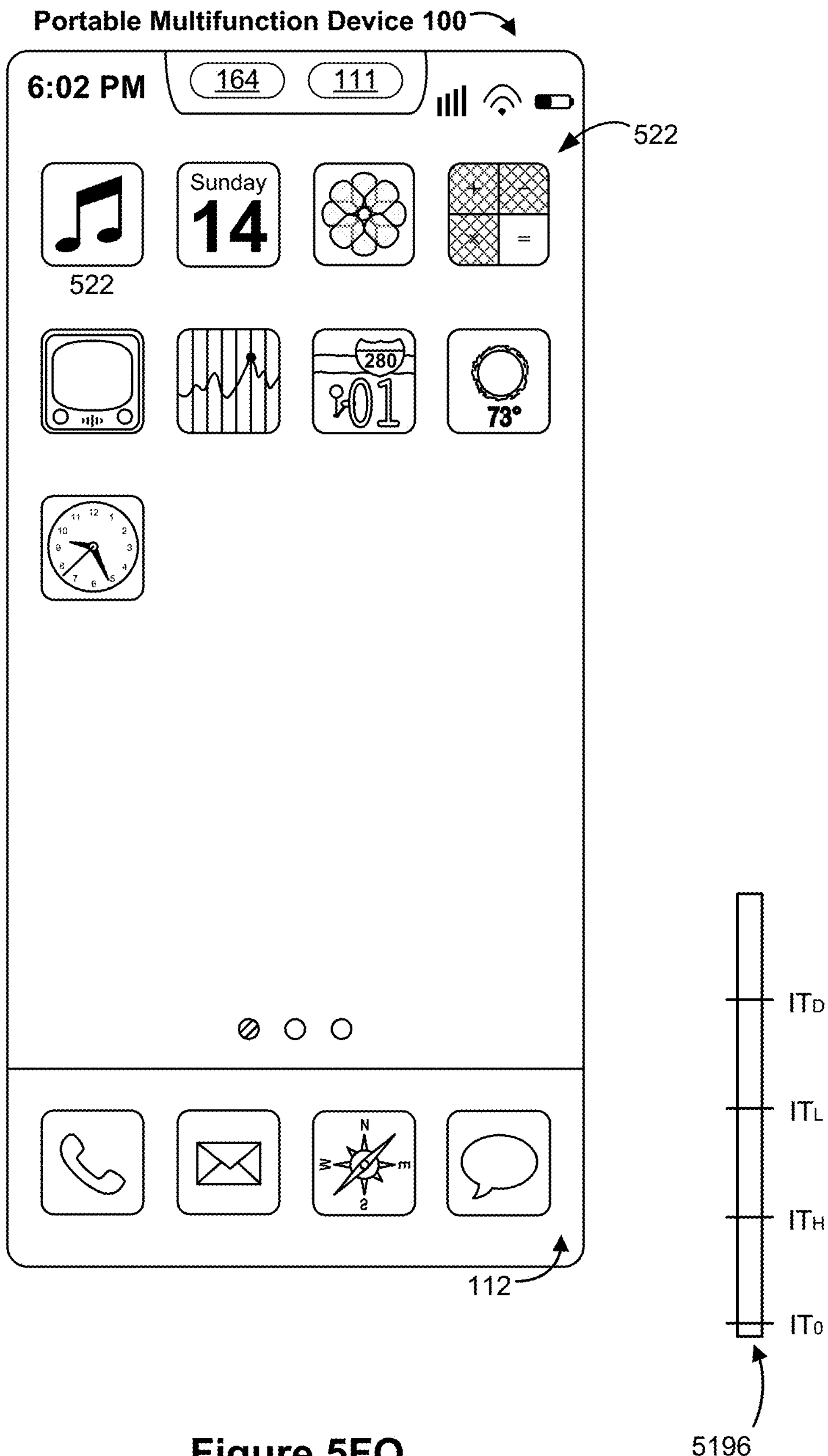
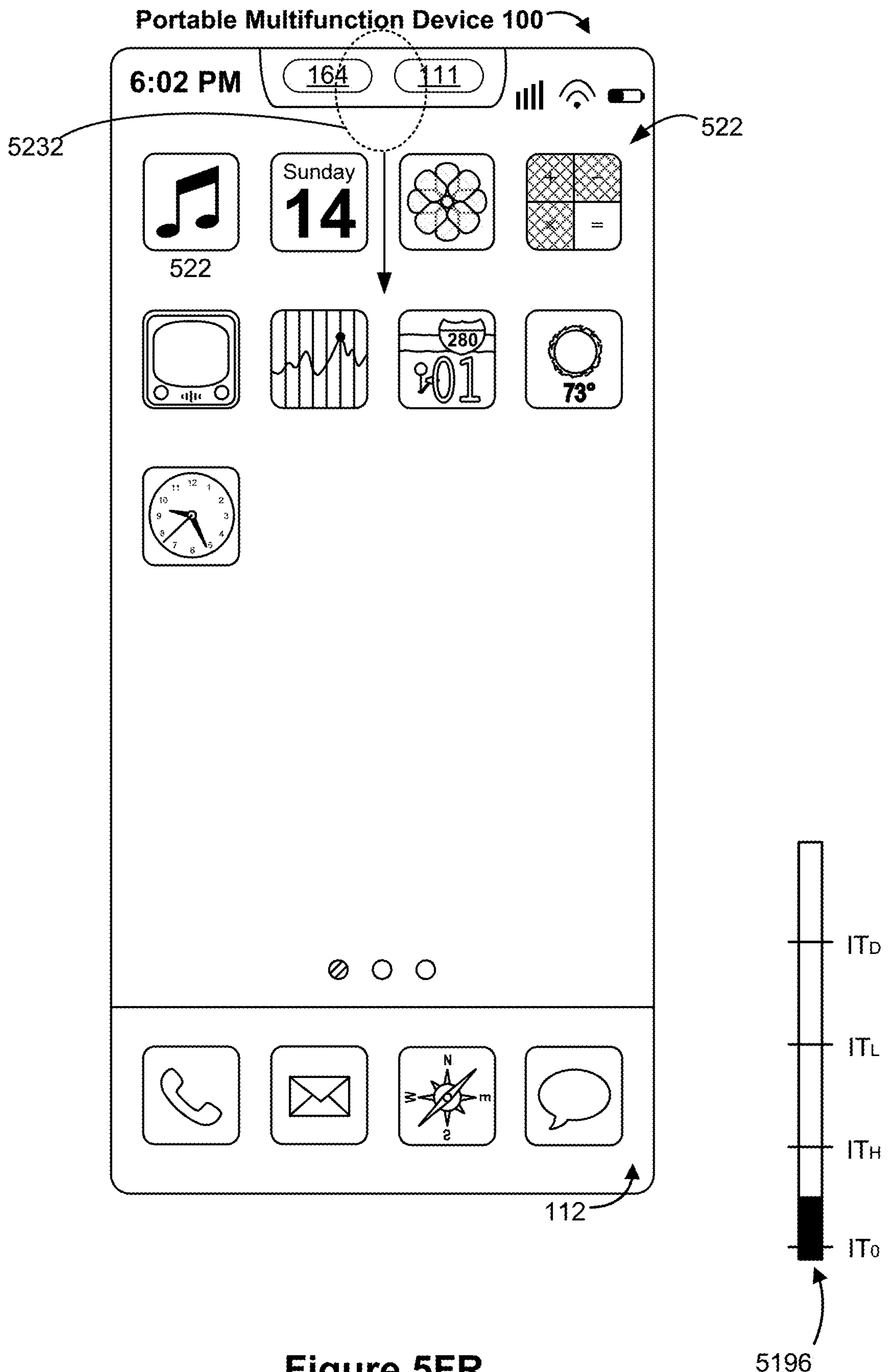
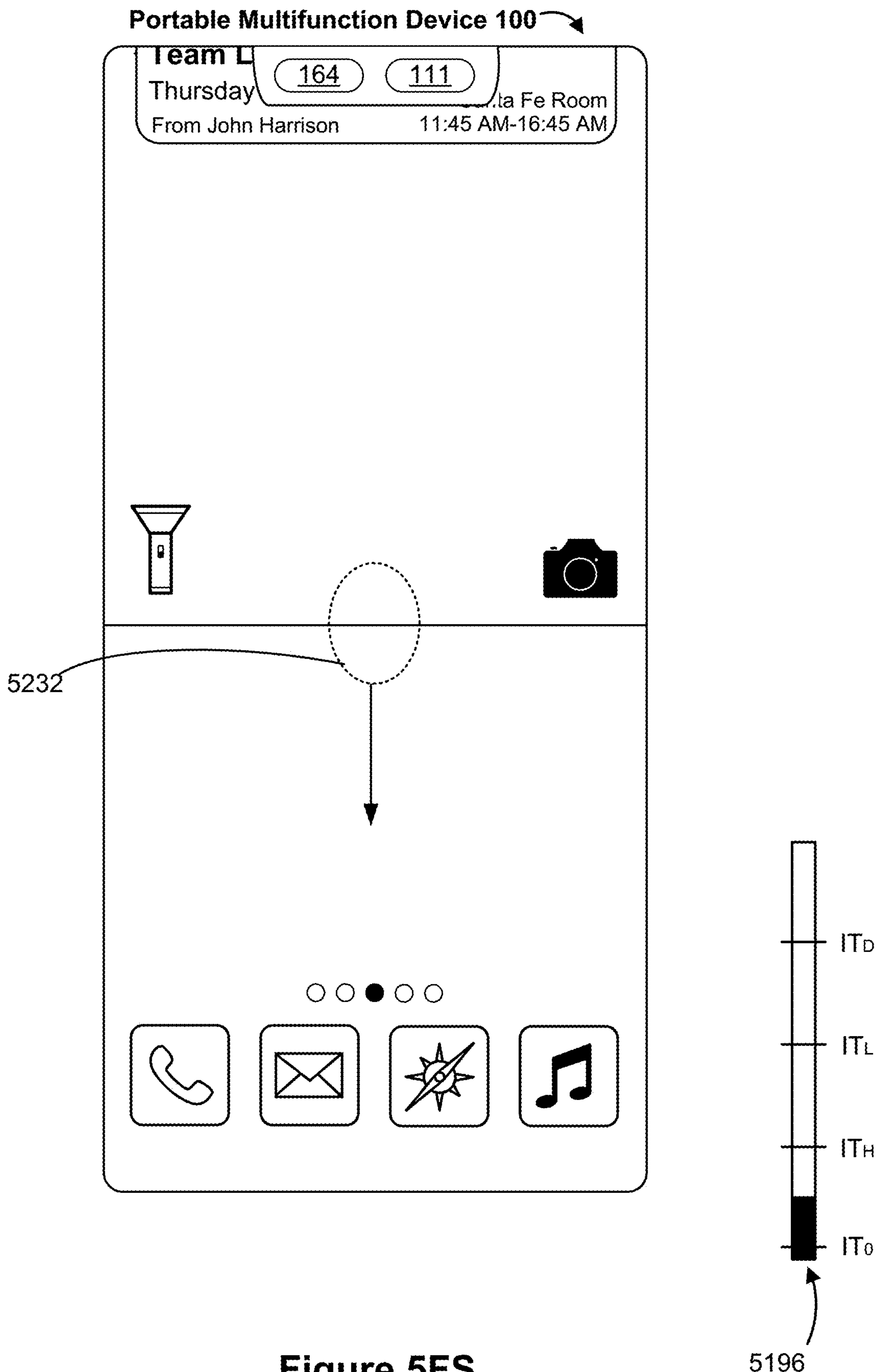

Portable Multifunction Device 100
6:02 PM
164
111
522
Sunday
14
522
280
73°
112
ITD
ITL
ITH
IT0
5196

Figure 5FQ



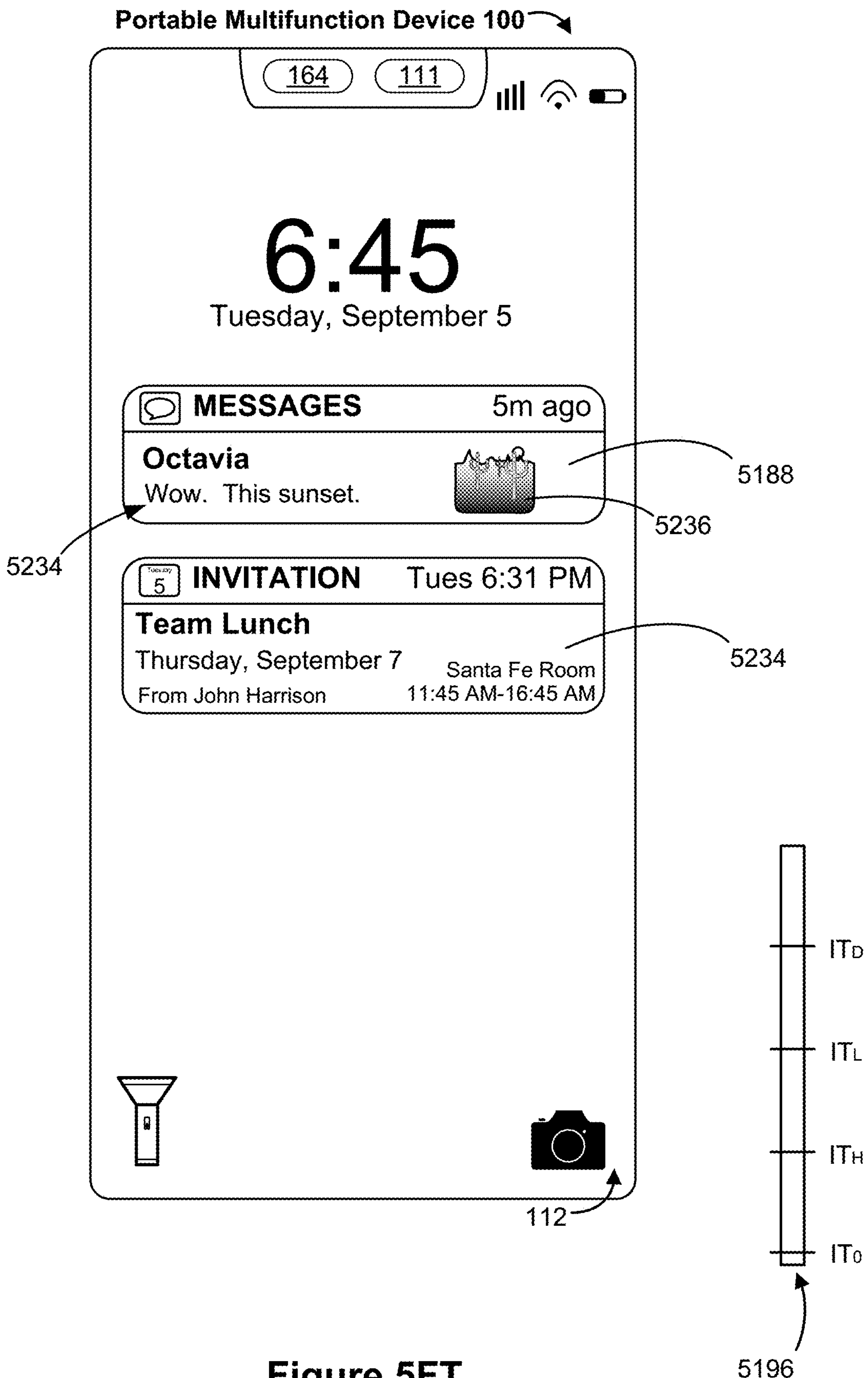
Portable Multifunction Device 100
6:02 PM
164
111
5232
522
Sunday
14
522
280
73°
112
ITD
ITL
ITH
IT0
5196

Figure 5FR



Portable Multifunction Device 100
Team L
Thursday
164
111
...ta Fe Room
From John Harrison
11:45 AM-16:45 AM
5232
ITD
ITL
ITH
IT0
5196

Figure 5FS



Portable Multifunction Device 100
164
111
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
5188
5236
5234
5
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
From John Harrison
Santa Fe Room
11:45 AM-16:45 AM
5234
112
ITD
ITL
ITH
IT0
5196

Figure 5FT

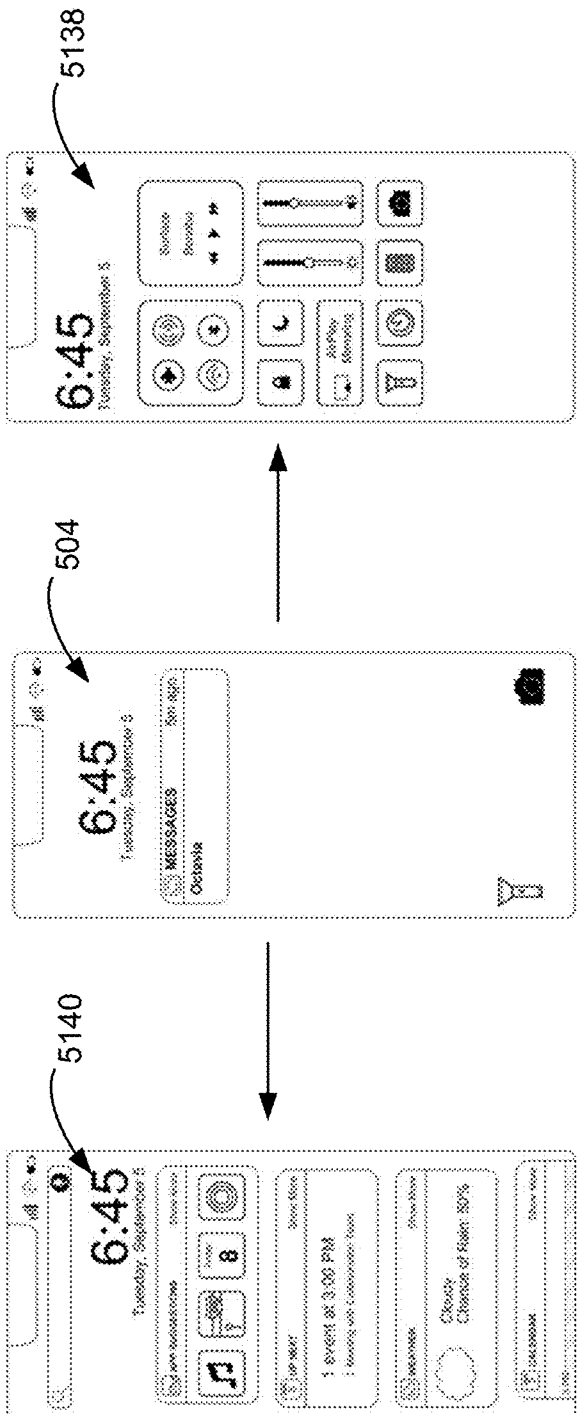
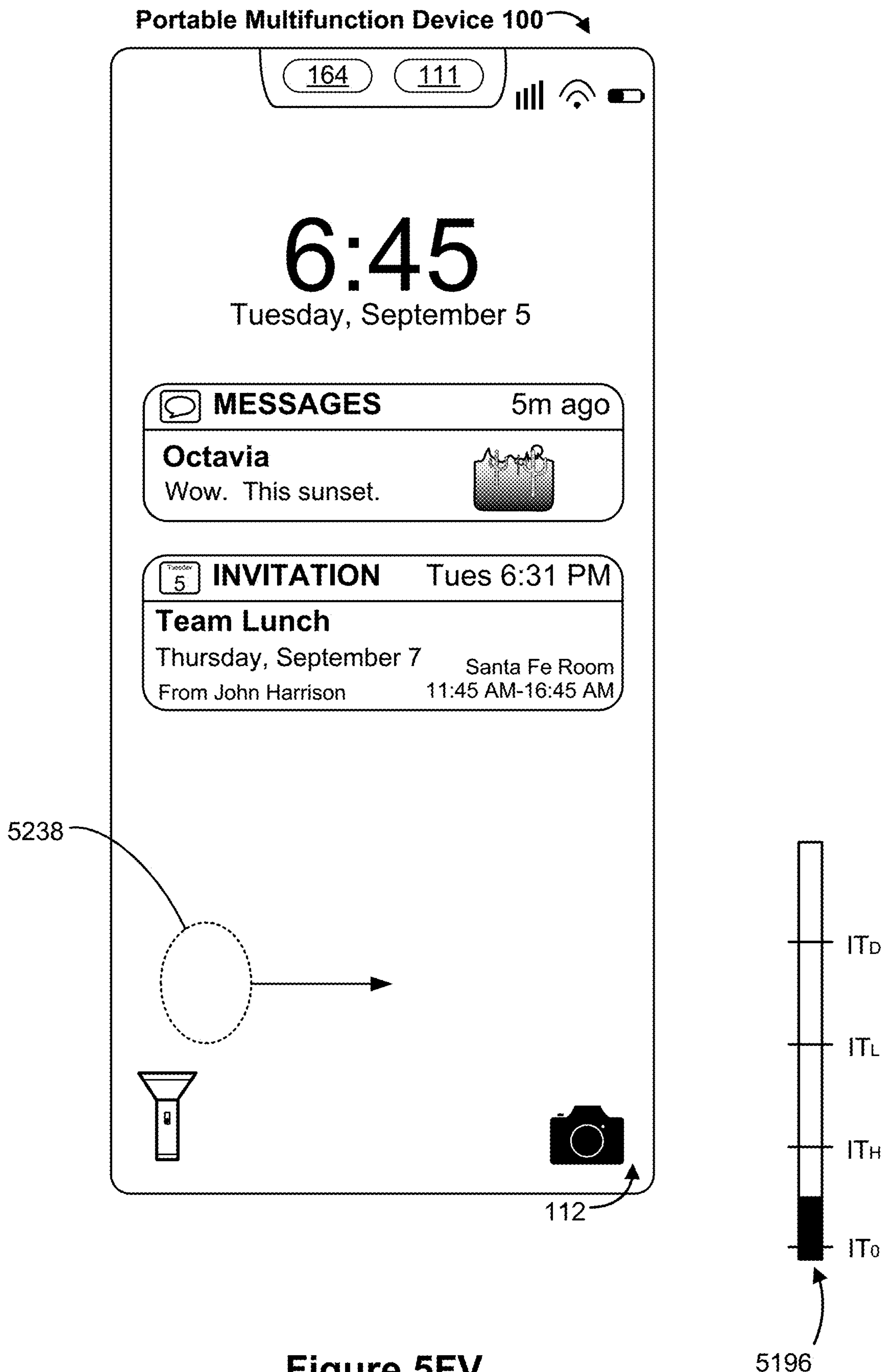
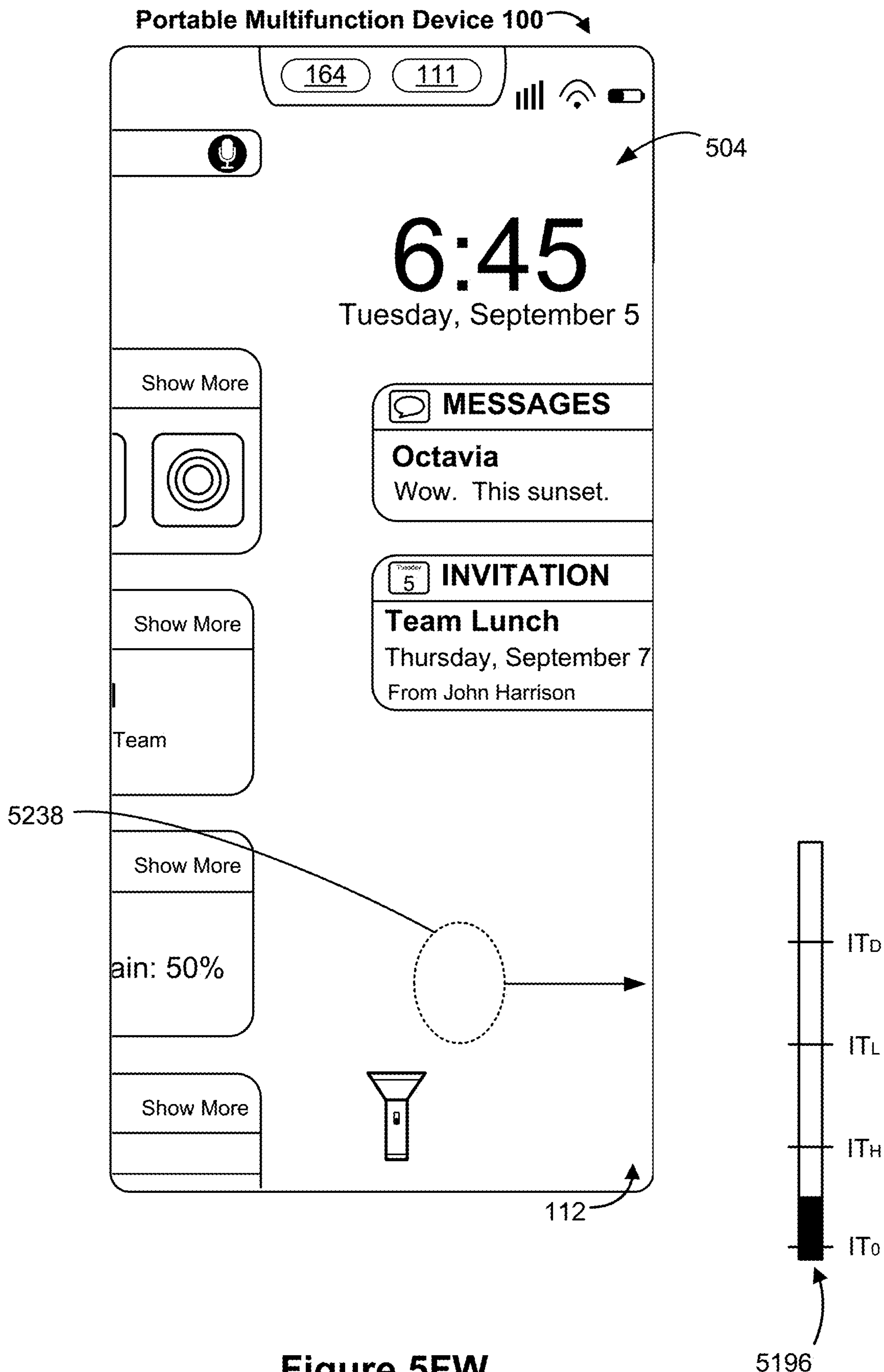


Figure 5FU



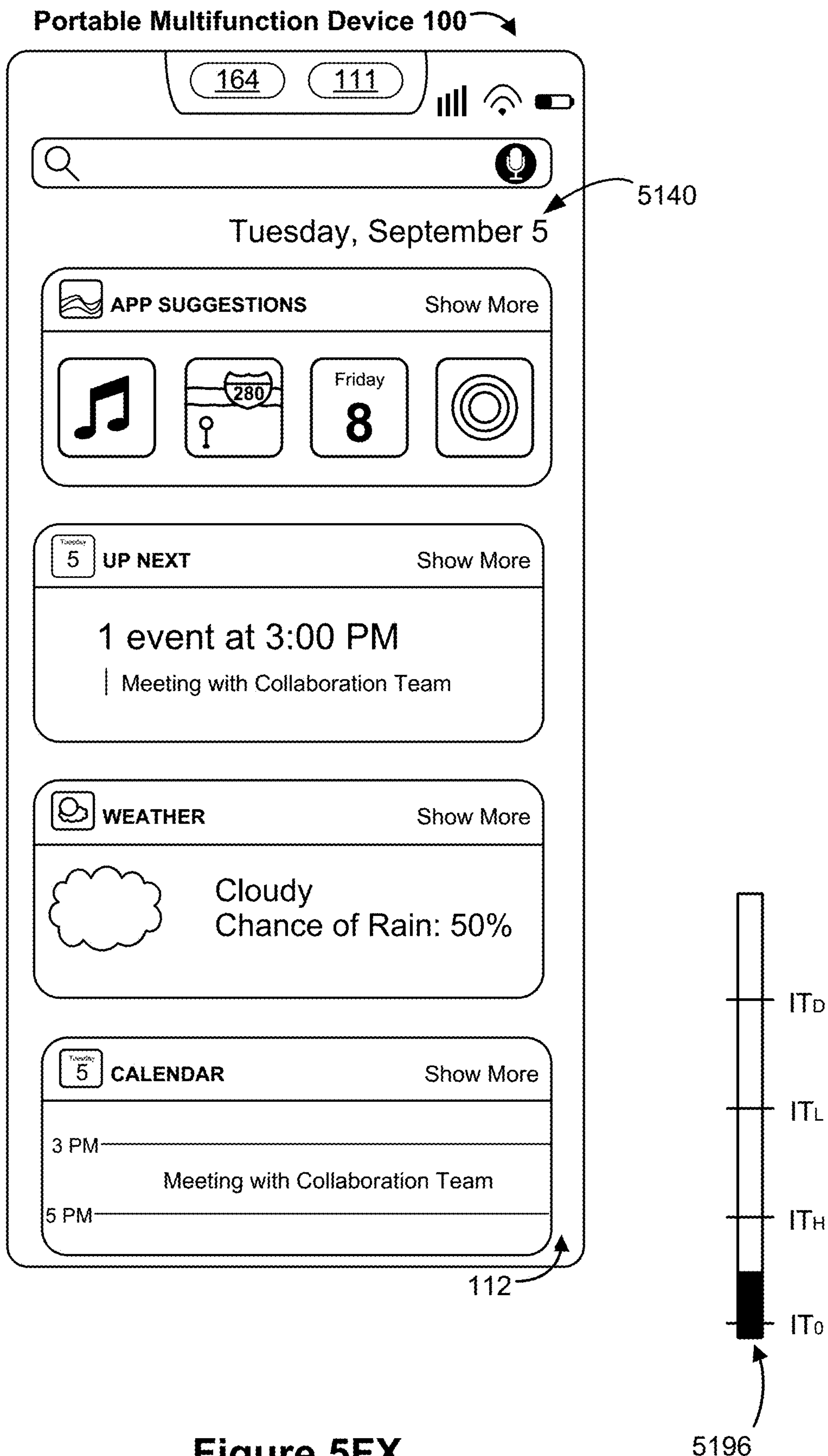
Portable Multifunction Device 100
164
111
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
5
Team Lunch
Thursday, September 7
Santa Fe Room
From John Harrison
11:45 AM-16:45 AM
5238
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FV



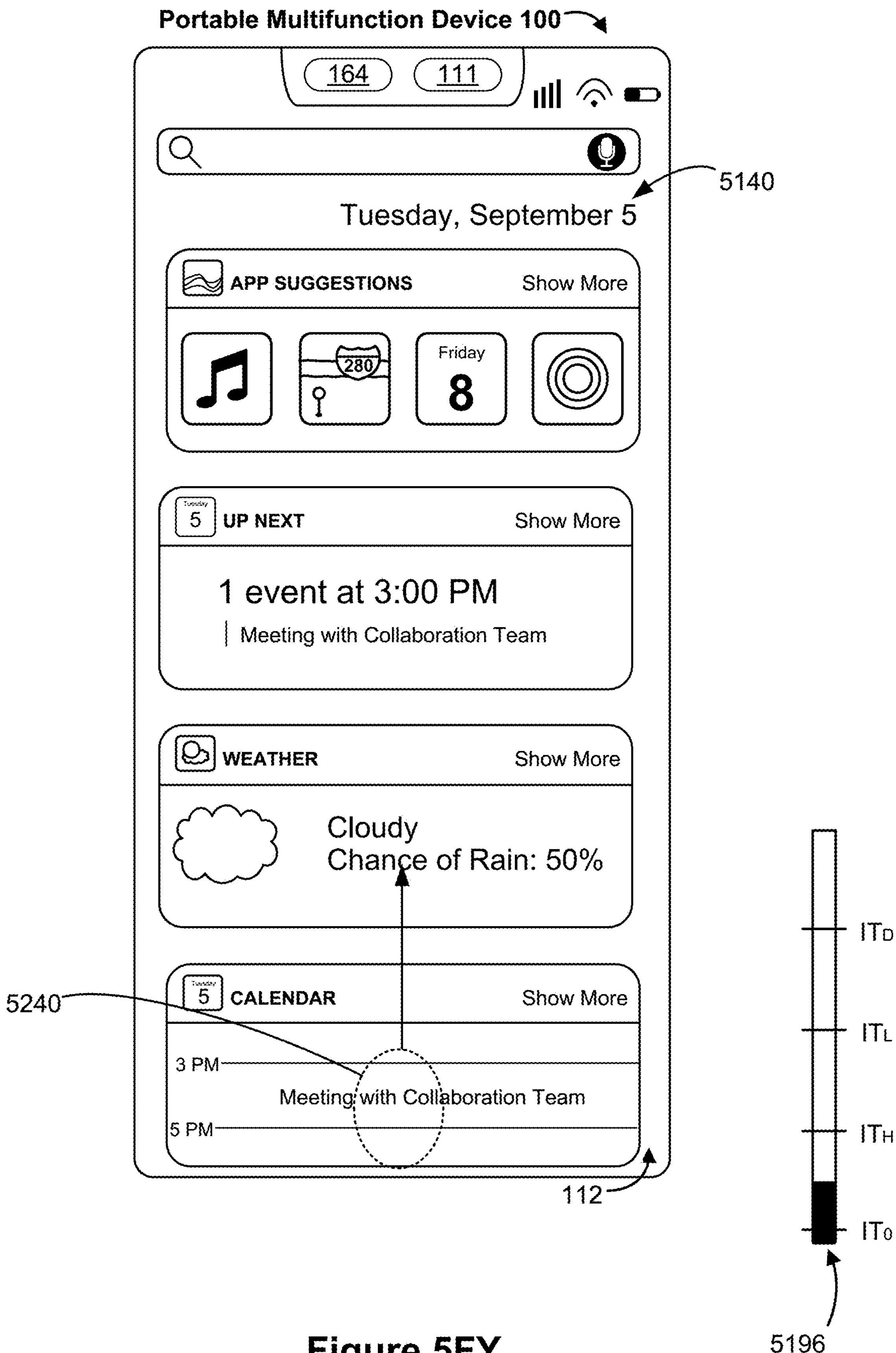
Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
Show More
MESSAGES
Octavia
Wow. This sunset.
INVITATION
5
Team Lunch
Thursday, September 7
From John Harrison
Show More
Team
5238
Show More
ain: 50%
Show More
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FW



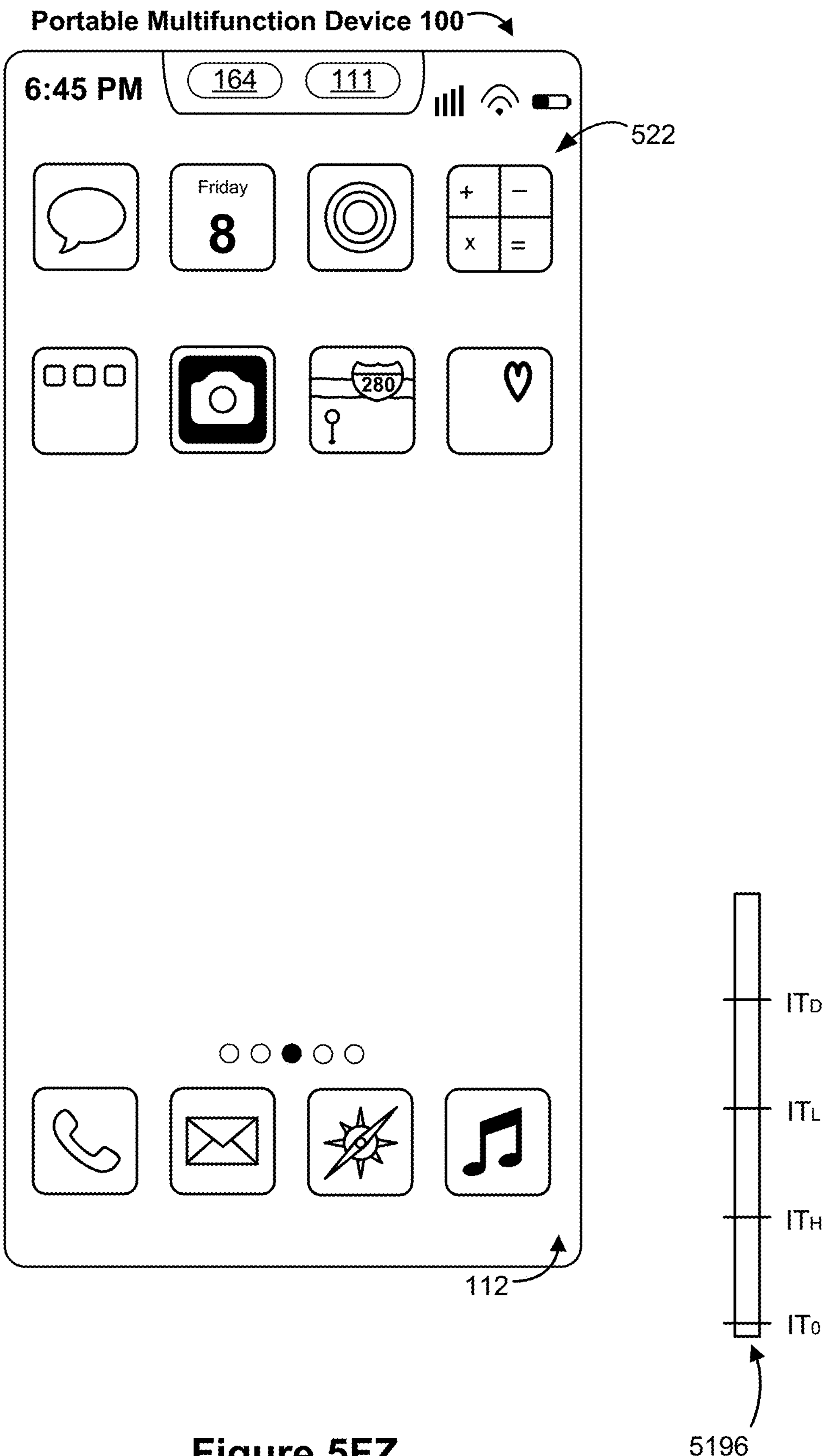
Portable Multifunction Device 100
164
111
5140
Tuesday, September 5
APP SUGGESTIONS
Show More
280
Friday
8
5
UP NEXT
Show More
1 event at 3:00 PM
Meeting with Collaboration Team
WEATHER
Show More
Cloudy
Chance of Rain: 50%
5
CALENDAR
Show More
3 PM
Meeting with Collaboration Team
5 PM
112
ITD
ITL
ITH
IT0
5196

Figure 5FX



Portable Multifunction Device 100
164
111
5140
Tuesday, September 5
APP SUGGESTIONS
Show More
280
Friday
8
5
UP NEXT
Show More
1 event at 3:00 PM
Meeting with Collaboration Team
WEATHER
Show More
Cloudy
Chance of Rain: 50%
5240
5
CALENDAR
Show More
3 PM
Meeting with Collaboration Team
5 PM
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FY



Portable Multifunction Device 100
6:45 PM
164
111
522
Friday
8
+
−
x
=
280
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5FZ

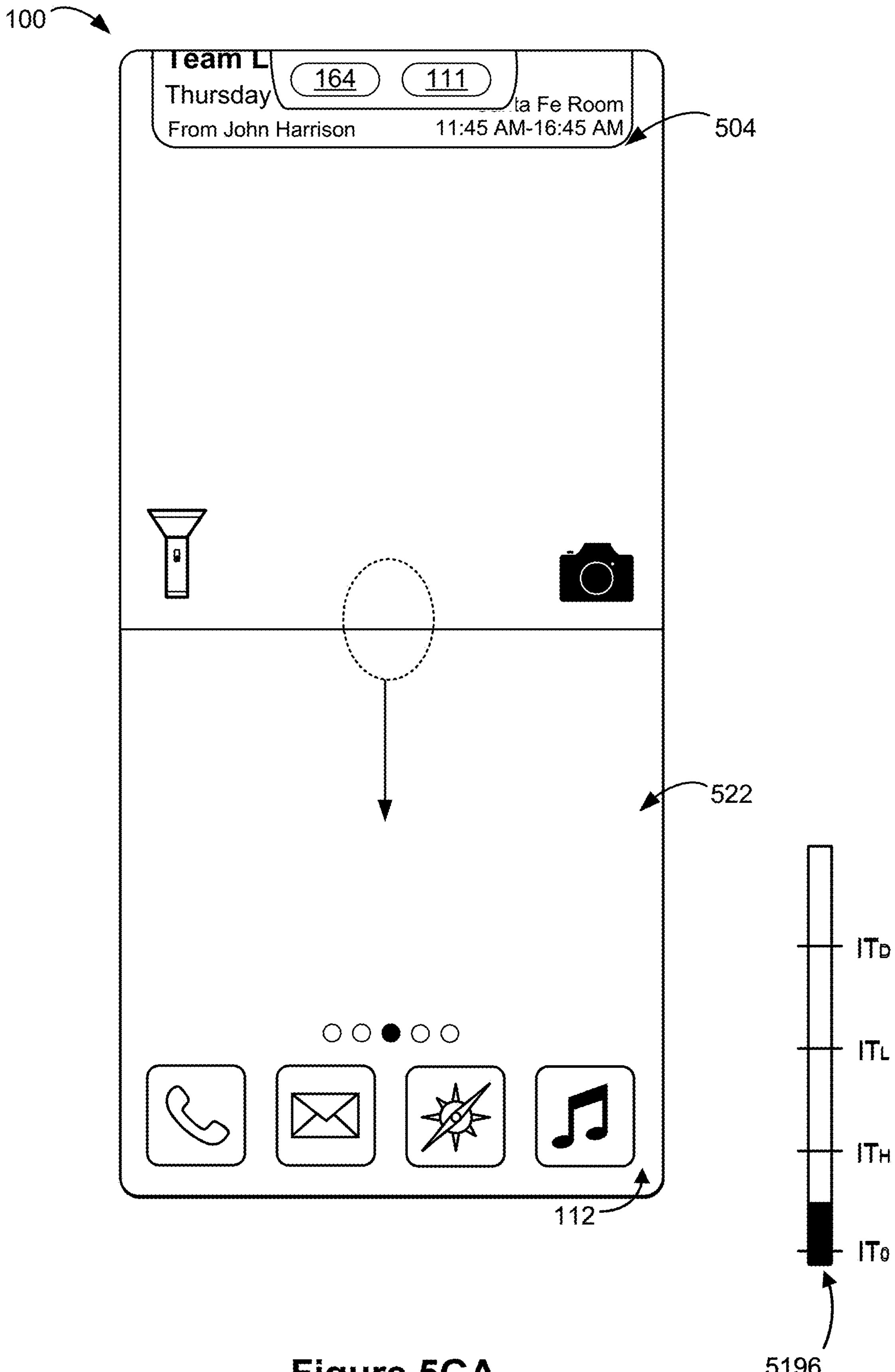
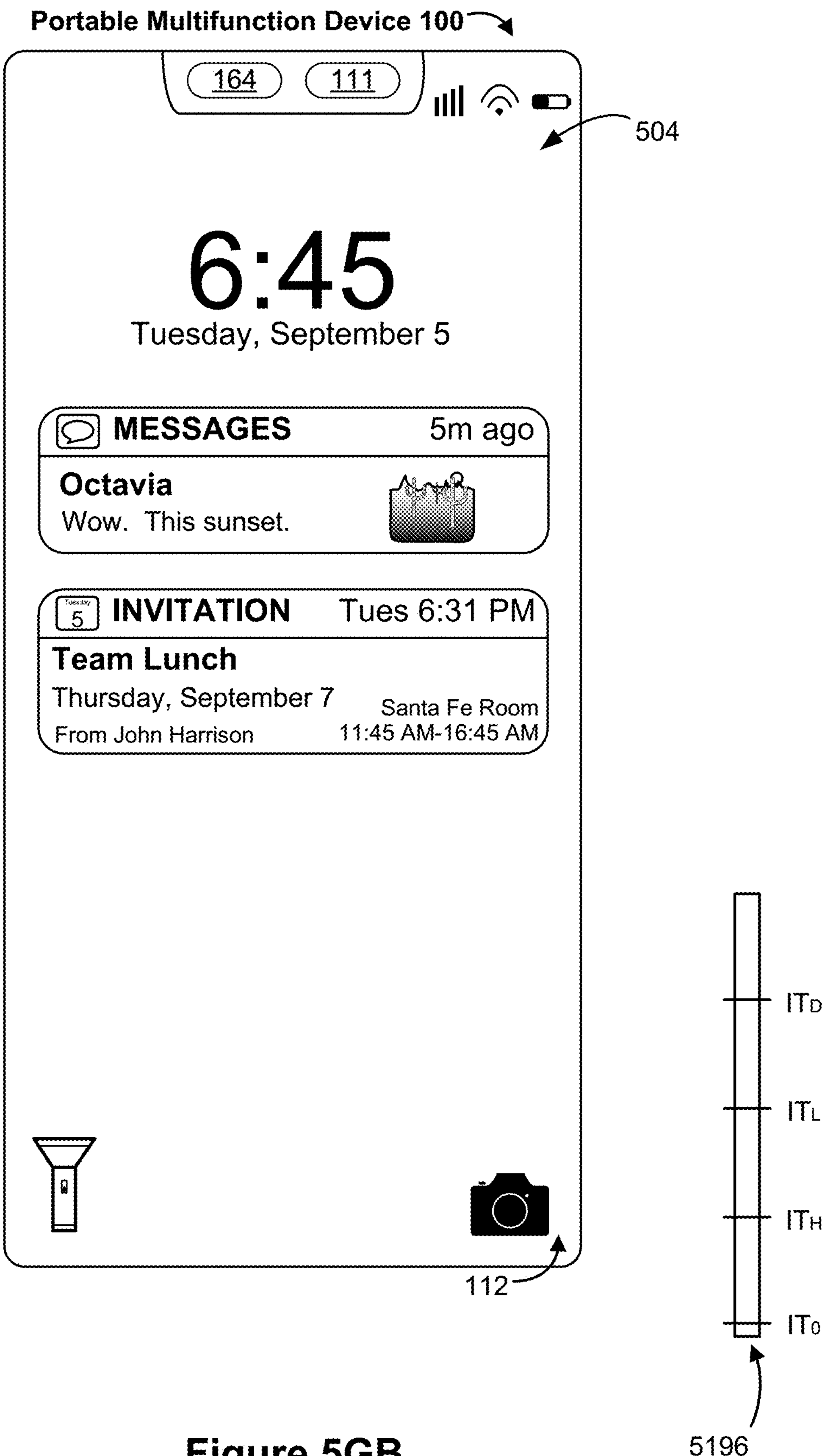

100
Team L
Thursday
164
111
ta Fe Room
From John Harrison
11:45 AM-16:45 AM
504
522
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5GA



Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
5
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
Santa Fe Room
From John Harrison
11:45 AM-16:45 AM
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5GB

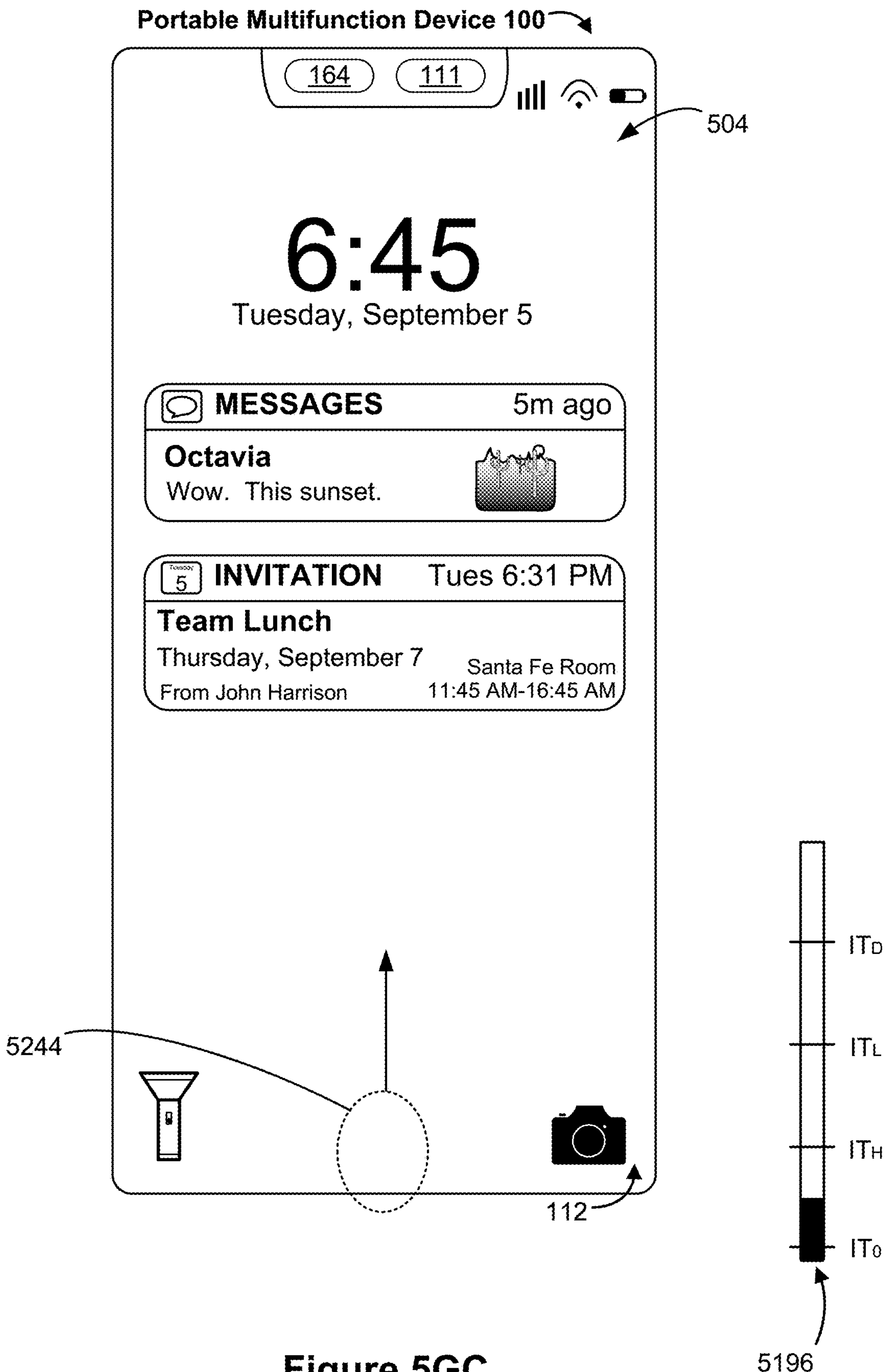
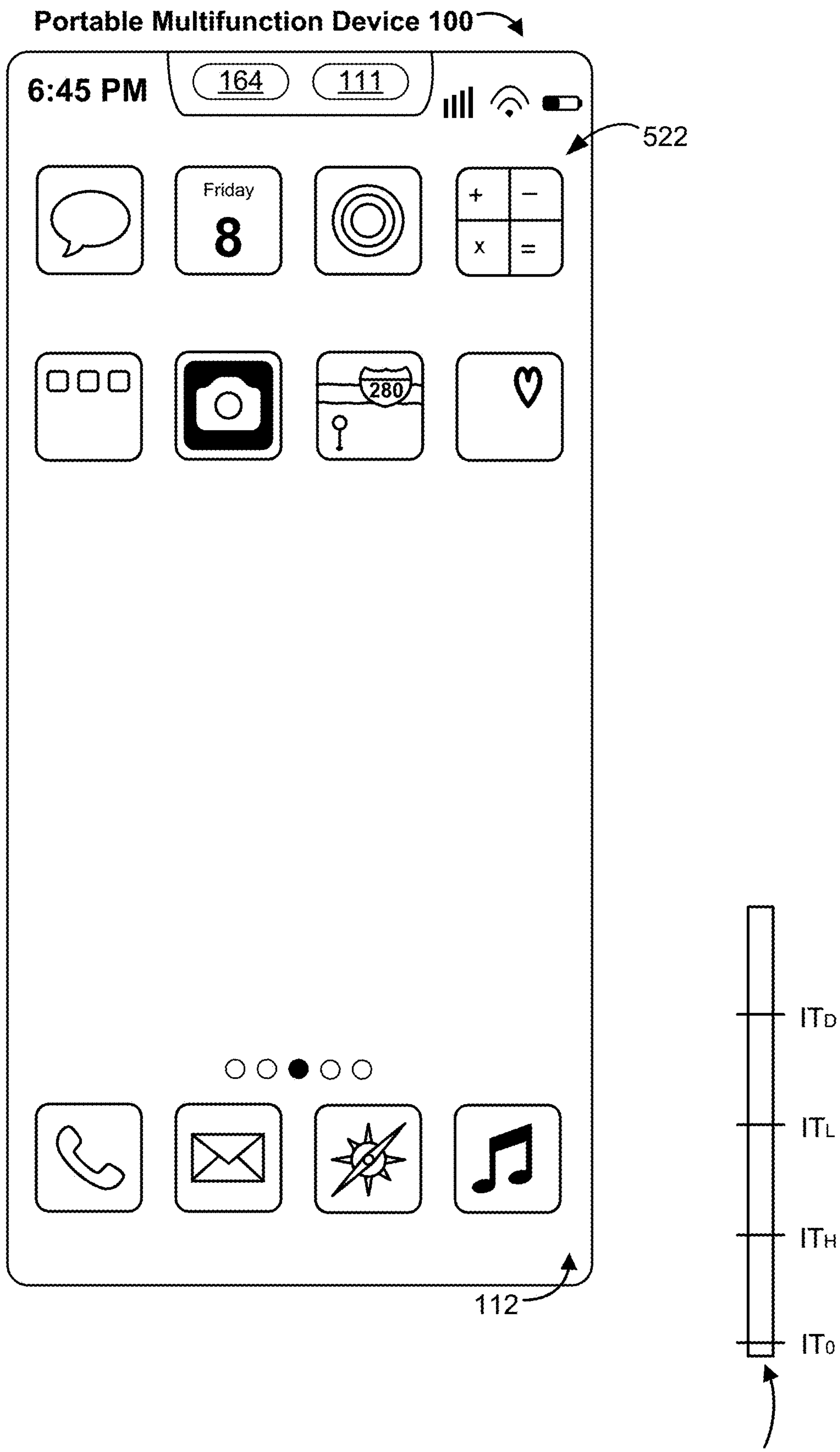
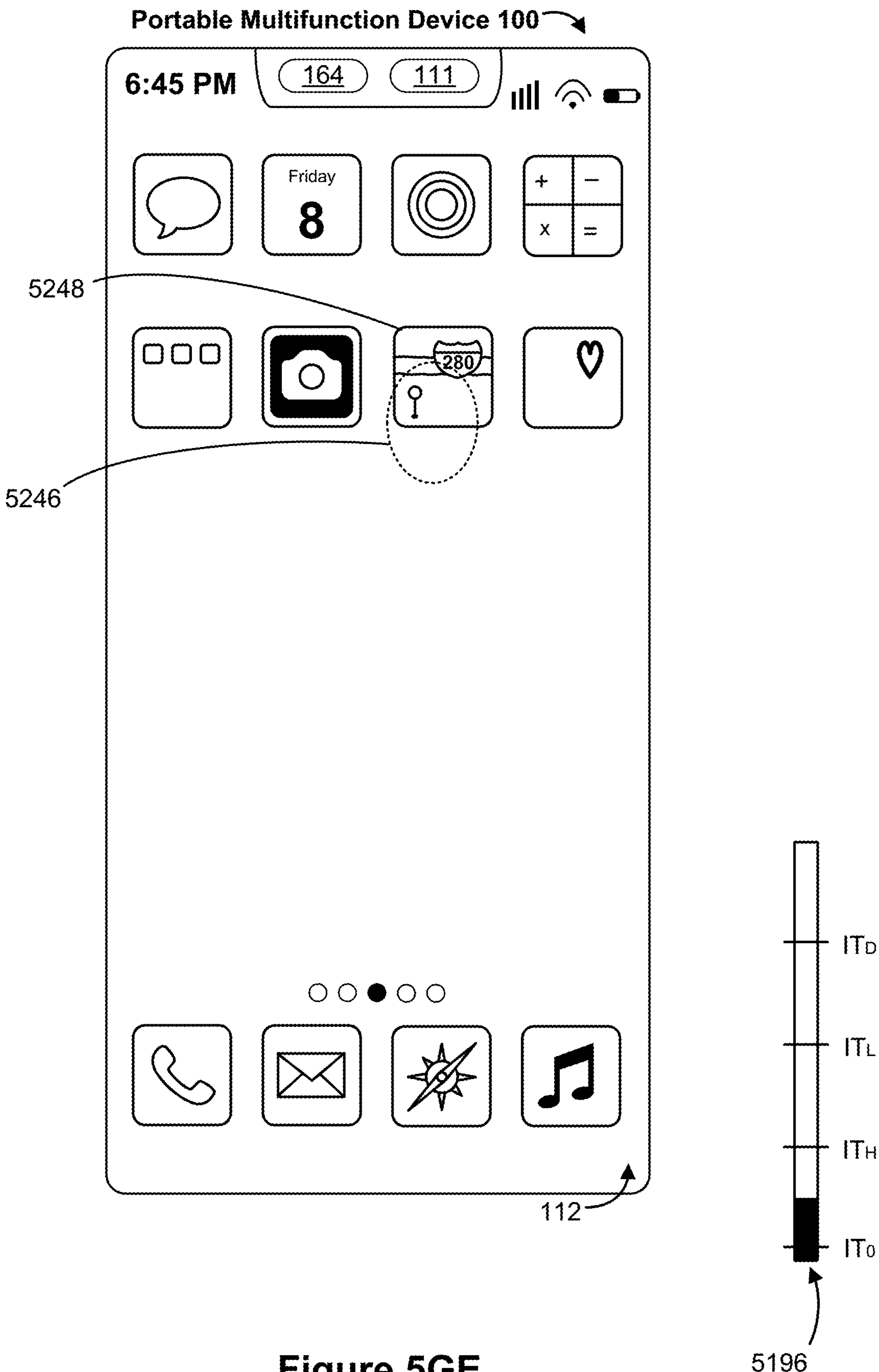

Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
5
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
Santa Fe Room
From John Harrison
11:45 AM-16:45 AM
5244
112
ITD
ITL
ITH
IT0
5196

Figure 5GC



Portable Multifunction Device 100
6:45 PM
164
111
522
Friday
8
+
−
x
=
280
112
ITD
ITL
ITH
IT0
5196

Figure 5GD



Portable Multifunction Device 100
6:45 PM
164
111
Friday
8
+
−
x
=
280
5248
5246
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5GE

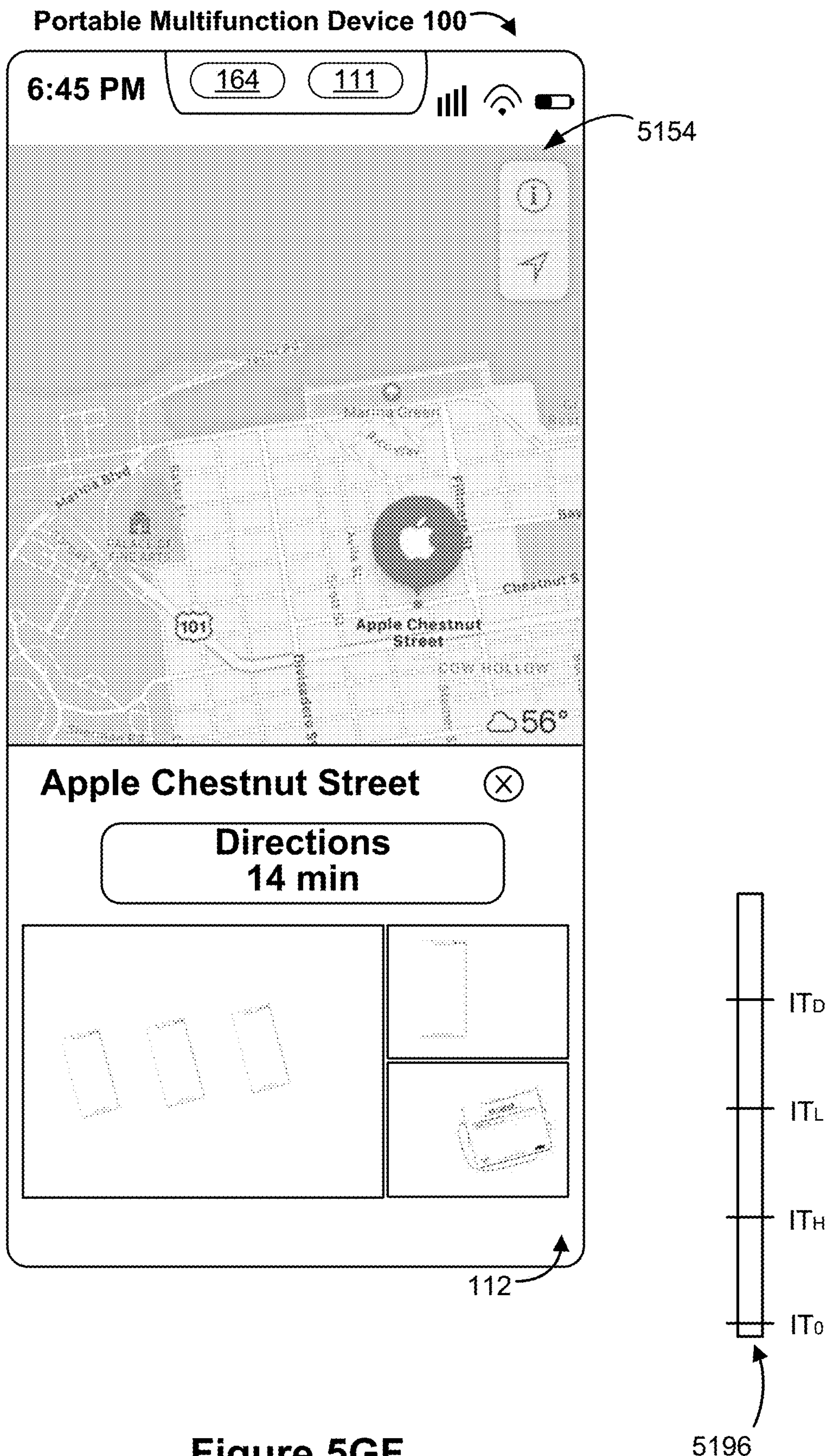
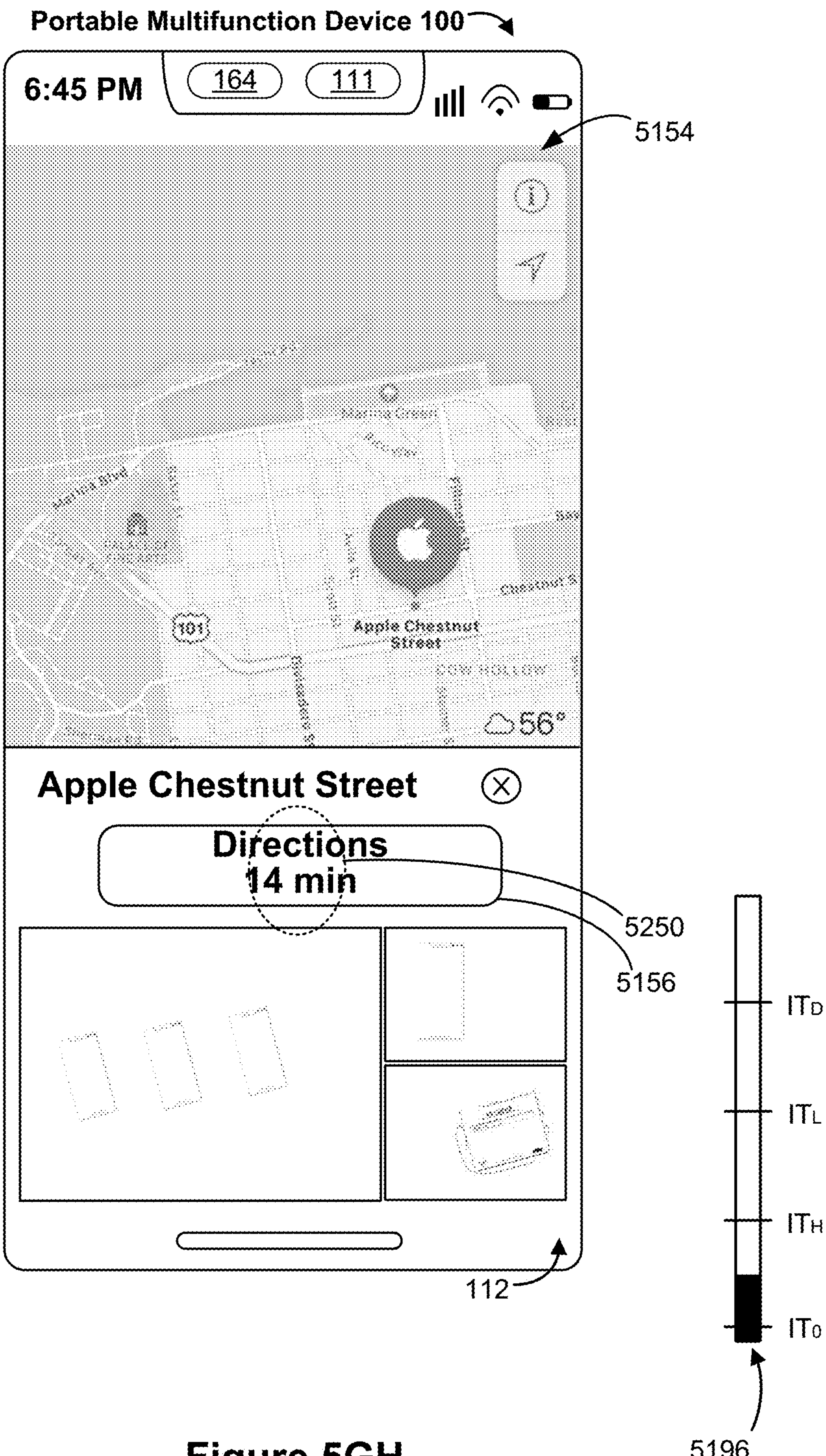
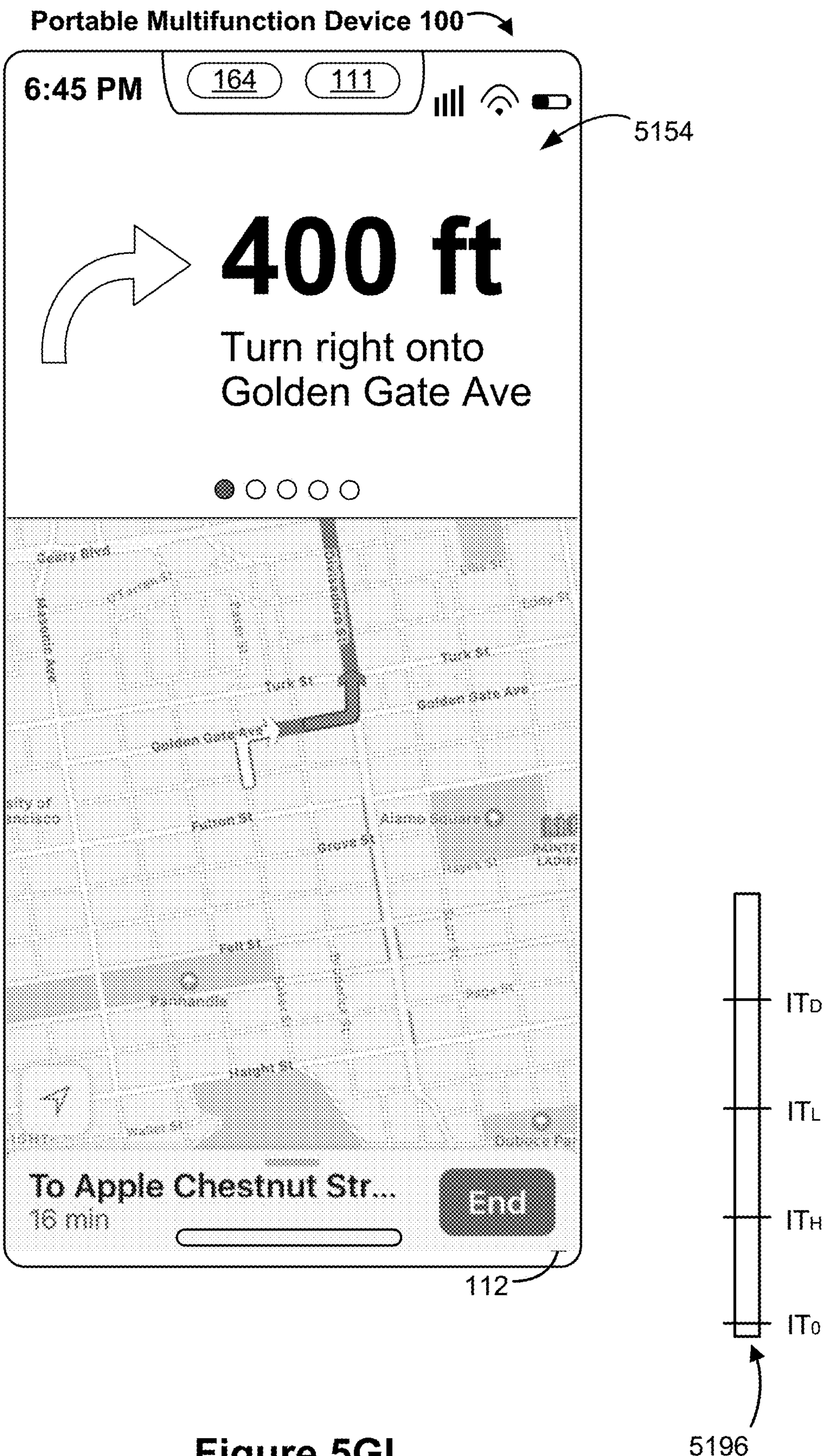

Portable Multifunction Device 100
6:45 PM
164
111
5154
Apple Chestnut Street
56°
Apple Chestnut Street
Directions
14 min
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5GF



Portable Multifunction Device 100
6:45 PM
164
111
5154
Marina Blvd
101
Apple Chestnut Street
Chestnut St
56°
Apple Chestnut Street
Directions
14 min
5250
5156
112
ITD
ITL
ITH
IT0
5196

Figure 5GH



Portable Multifunction Device 100
6:45 PM
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
Turk St
Golden Gate Ave
Fulton St
Grove St
Alamo Square
Fell St
Panhandle
Haight St
To Apple Chestnut Str...
16 min
End
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5GI

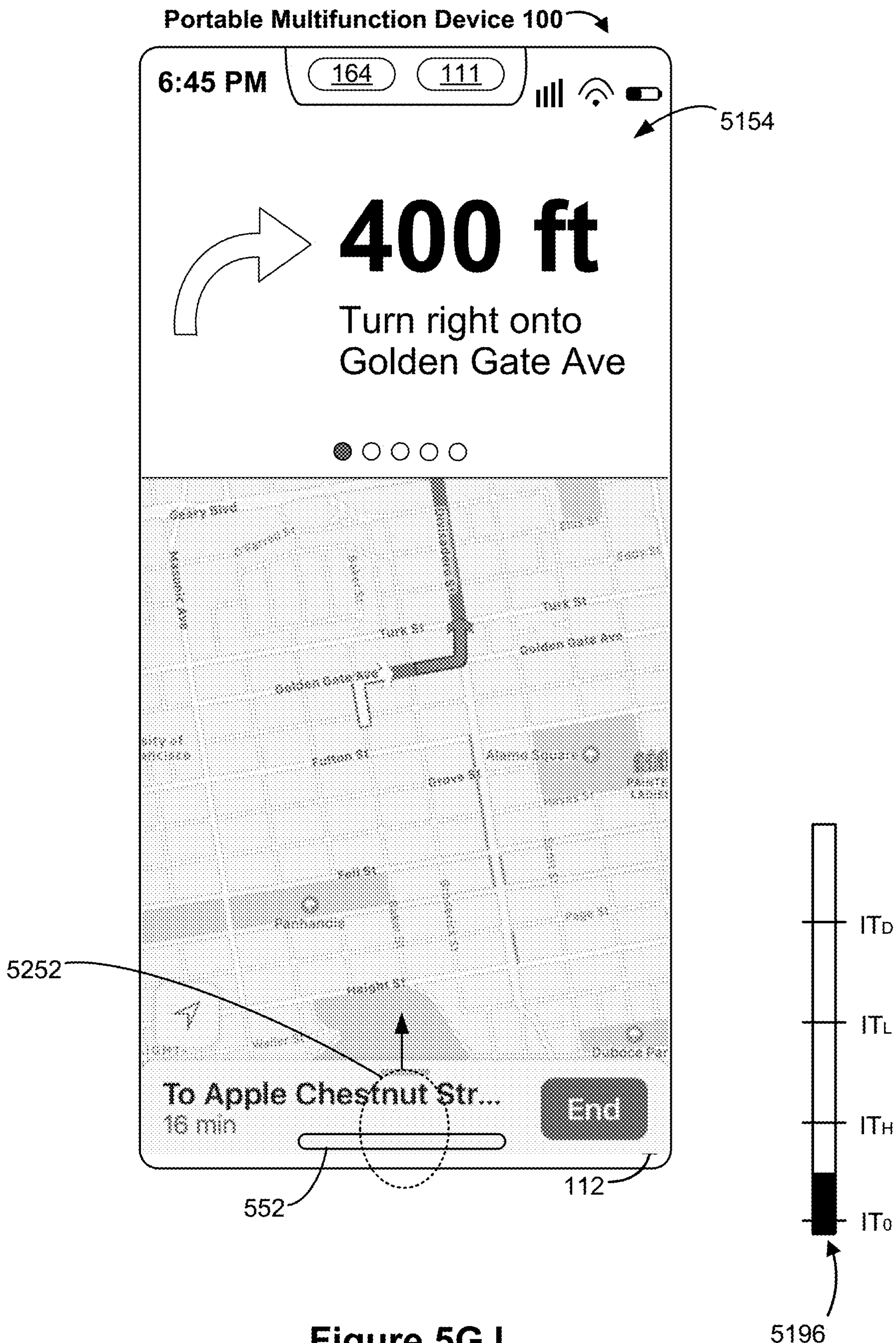

Portable Multifunction Device 100
6:45 PM
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
Geary Blvd
Turk St
Golden Gate Ave
Fulton St
Alamo Square
Fell St
Haight St
Panhandle
To Apple Chestnut Str...
16 min
End
5252
552
112
ITD
ITL
ITH
IT0
5196

Figure 5GJ

Portable Multifunction Device 100
6:45 PM
164
111
5154
400 ft
Turn right onto
Golden Gate Ave
Geary Blvd
Turk St
Golden Gate Ave
Fulton St
Grove St
Alamo Square
5252
112
ITD
ITL
ITH
IT0
5196

Figure 5GK

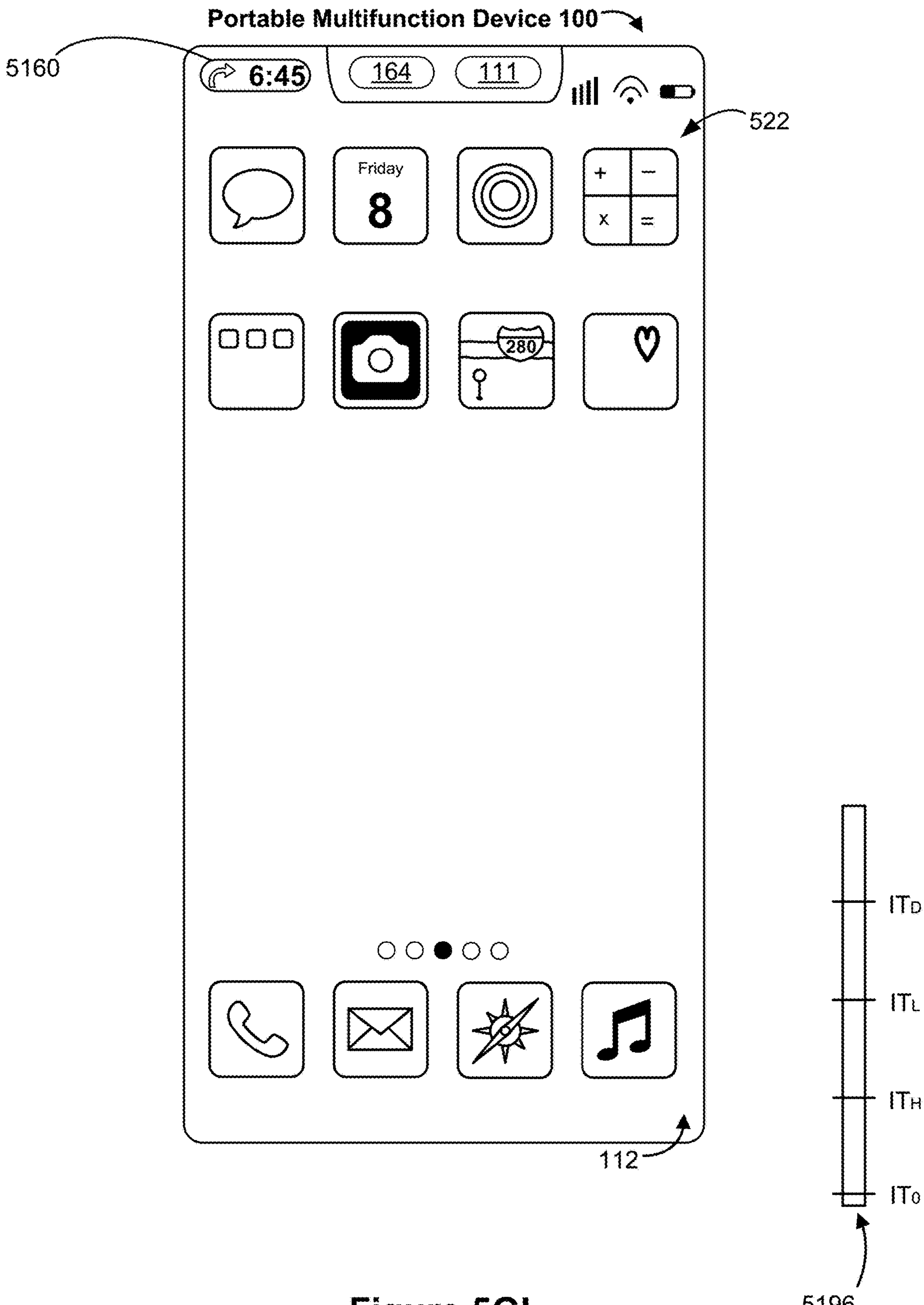
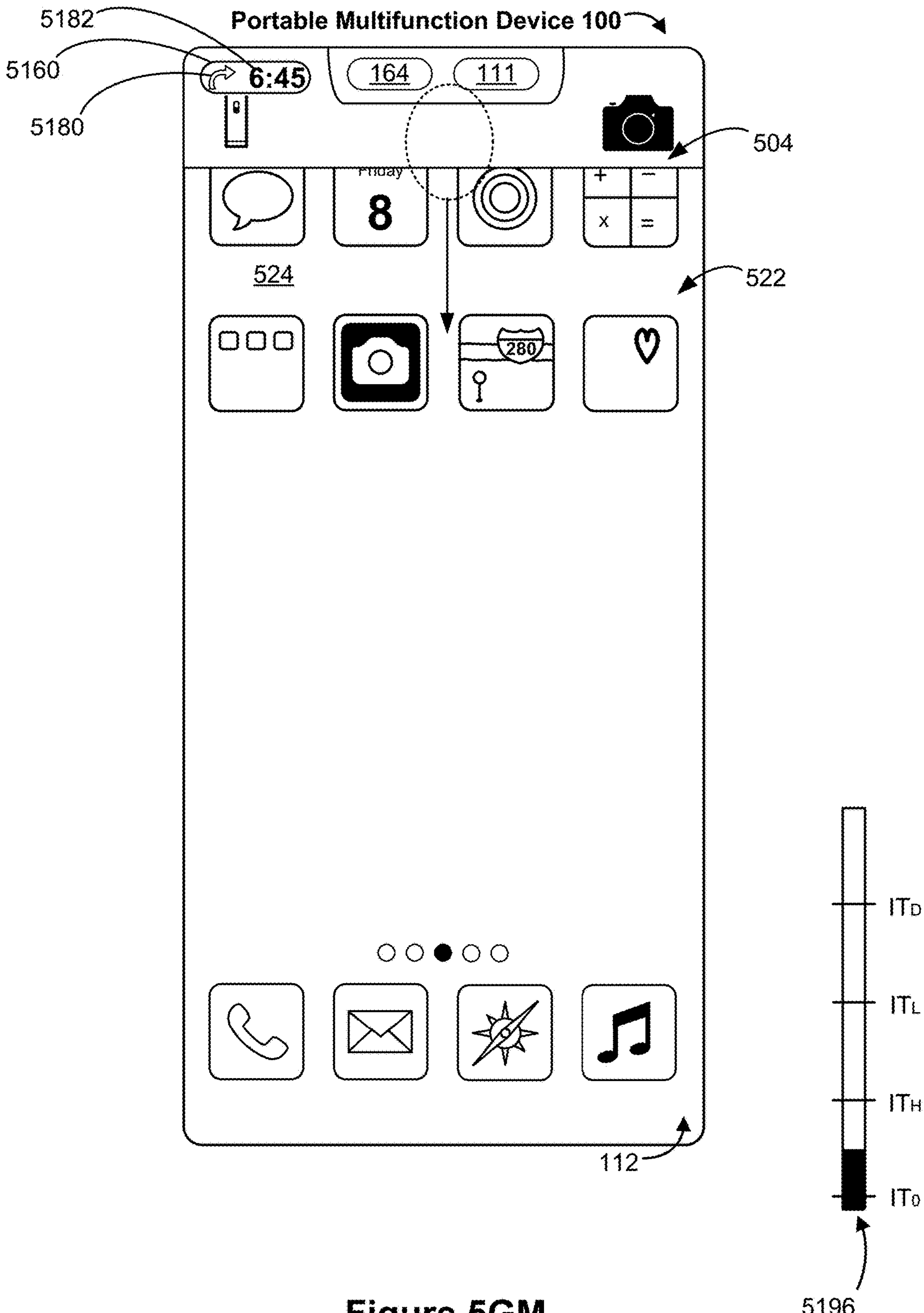

Portable Multifunction Device 100
5160
6:45
164
111
522
Friday
8
280
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5GL



Portable Multifunction Device 100
5182
5160
5180
6:45
164
111
504
Friday
8
x
=
524
522
280
112
ITD
ITL
ITH
IT0
5196

Figure 5GM

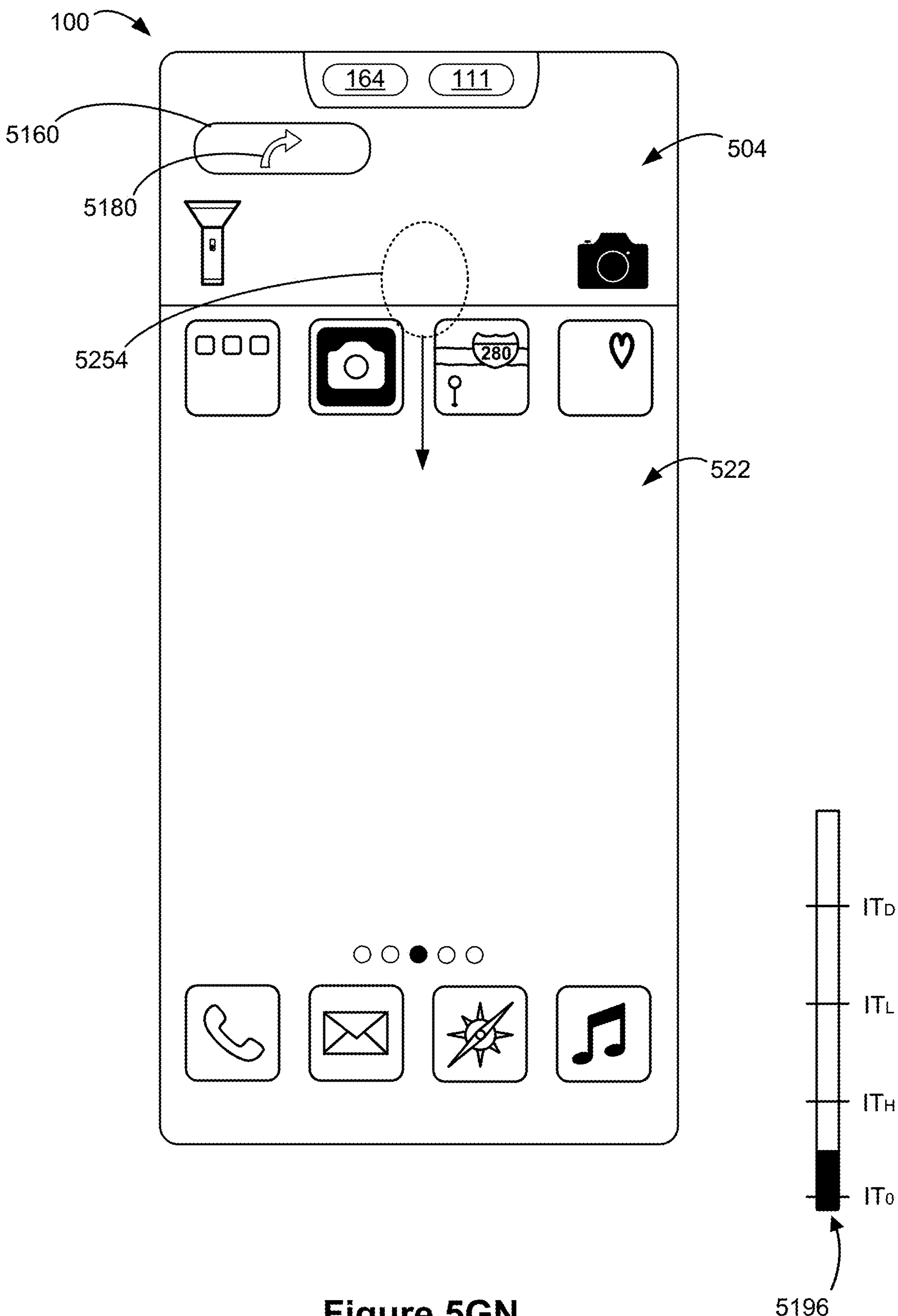


Figure 5GN

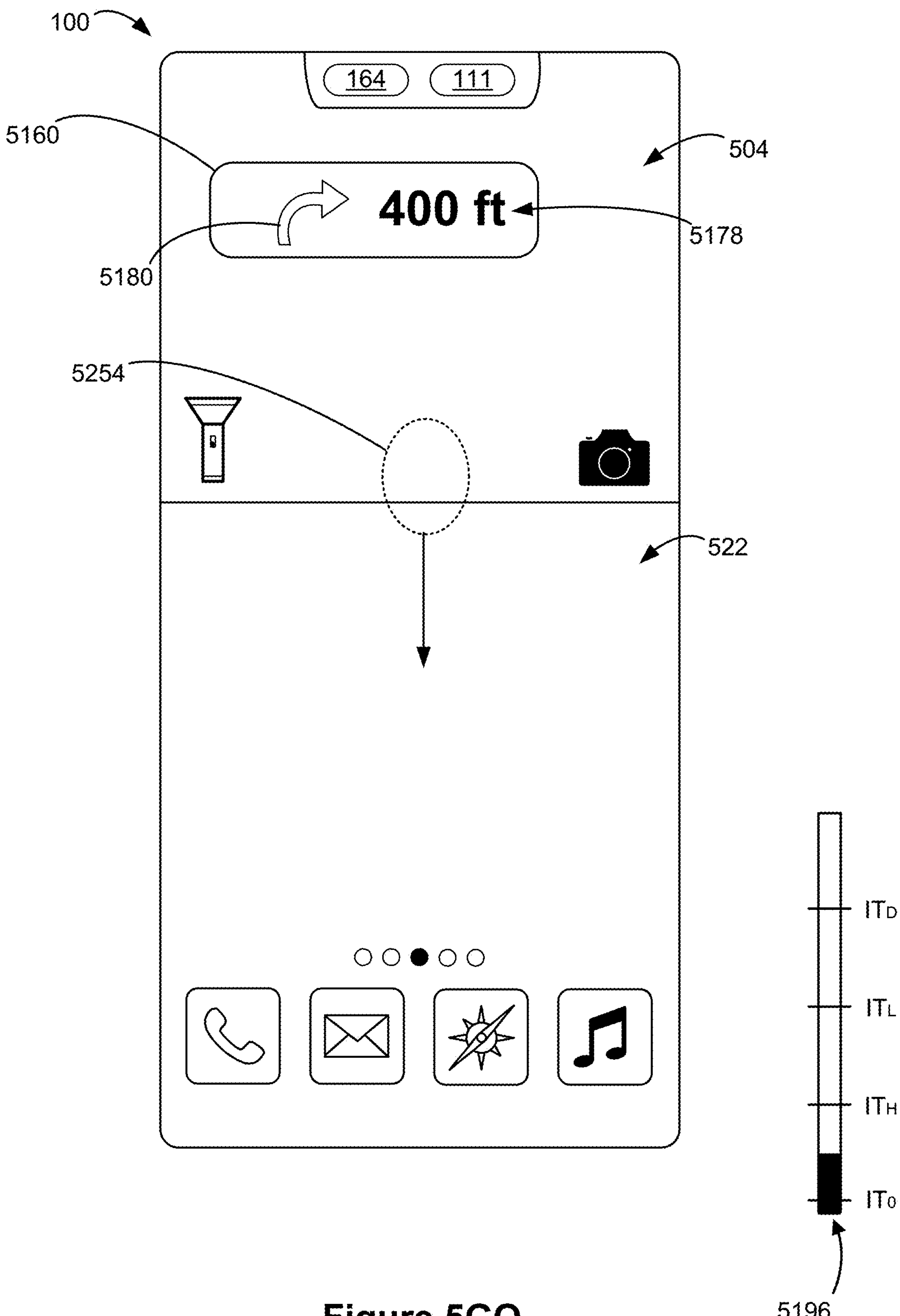

100
164
111
5160
504
400 ft
5178
5180
5254
522
IT_D
IT_L
IT_H
IT_0
5196

Figure 5GO

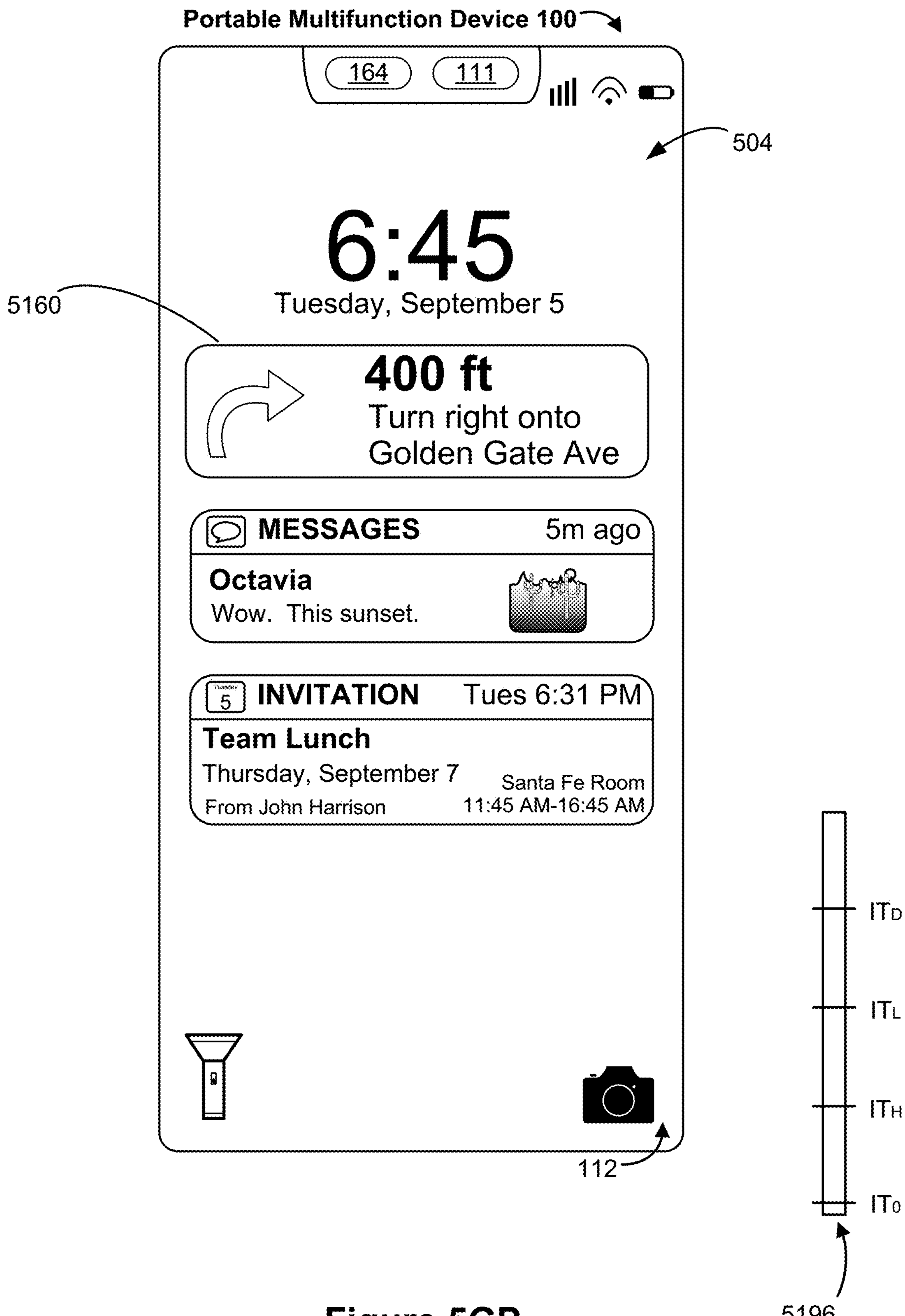
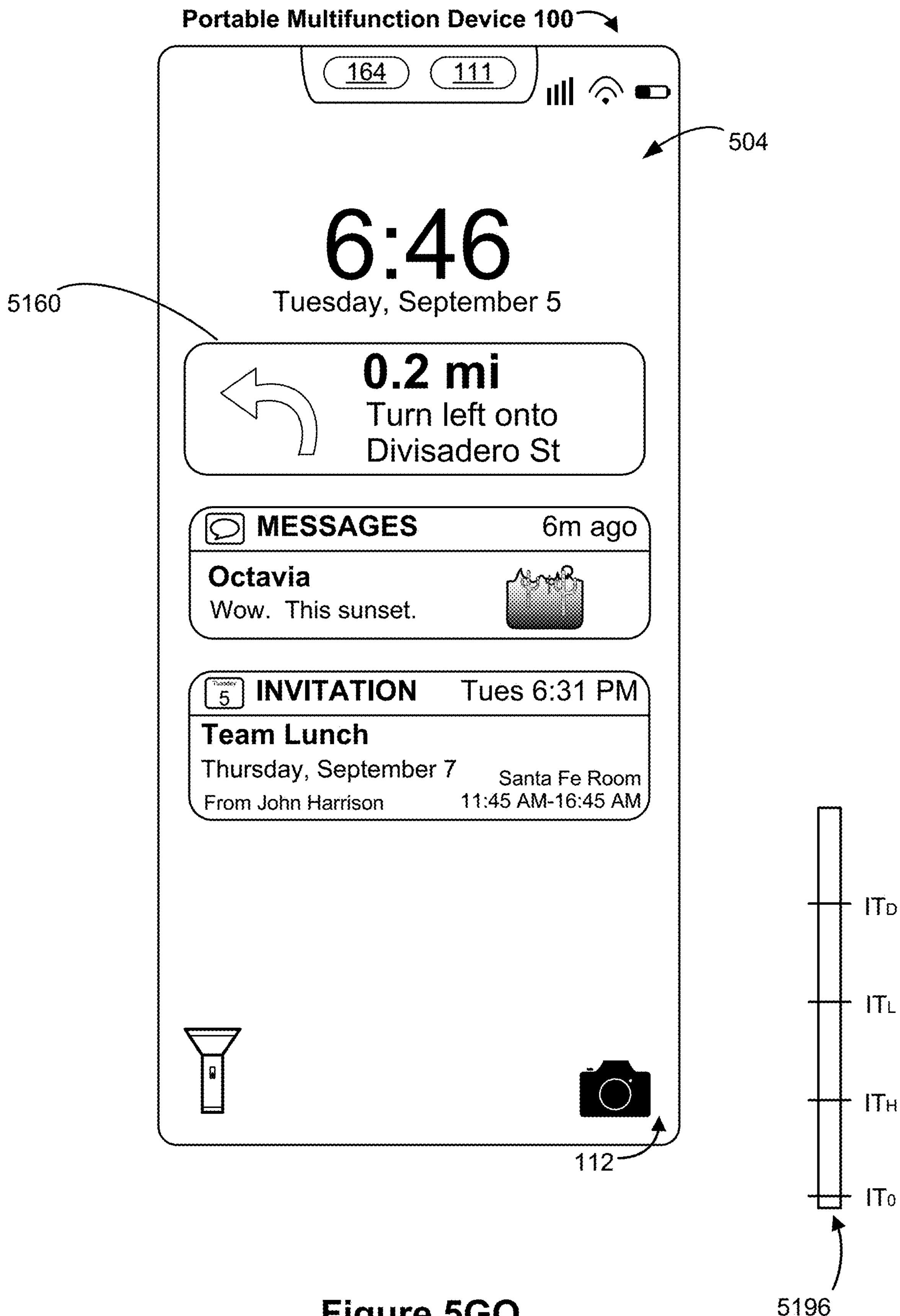
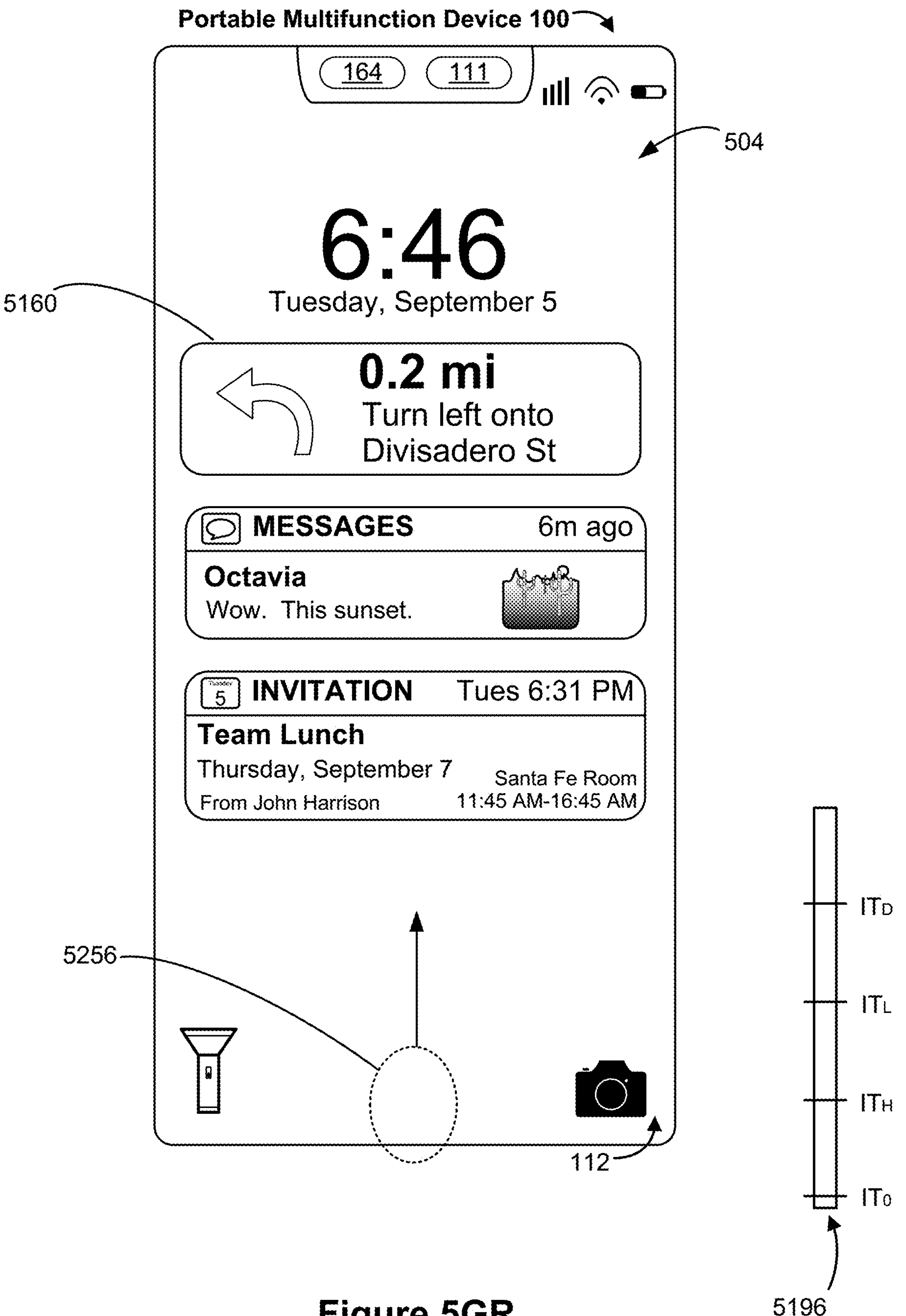

Portable Multifunction Device 100
164
111
504
6:45
Tuesday, September 5
5160
400 ft
Turn right onto
Golden Gate Ave
MESSAGES
5m ago
Octavia
Wow. This sunset.
5
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
Santa Fe Room
From John Harrison
11:45 AM-16:45 AM
112
ITD
ITL
ITH
IT0
5196

Figure 5GP



Portable Multifunction Device 100
164
111
504
6:46
Tuesday, September 5
5160
0.2 mi
Turn left onto
Divisadero St
MESSAGES
6m ago
Octavia
Wow. This sunset.
5
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
From John Harrison
Santa Fe Room
11:45 AM-16:45 AM
112
ITD
ITL
ITH
IT0
5196

Figure 5GQ



Portable Multifunction Device 100
164
111
504
6:46
Tuesday, September 5
5160
0.2 mi
Turn left onto
Divisadero St
MESSAGES
6m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
5
Team Lunch
Thursday, September 7
Santa Fe Room
From John Harrison
11:45 AM-16:45 AM
5256
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5GR

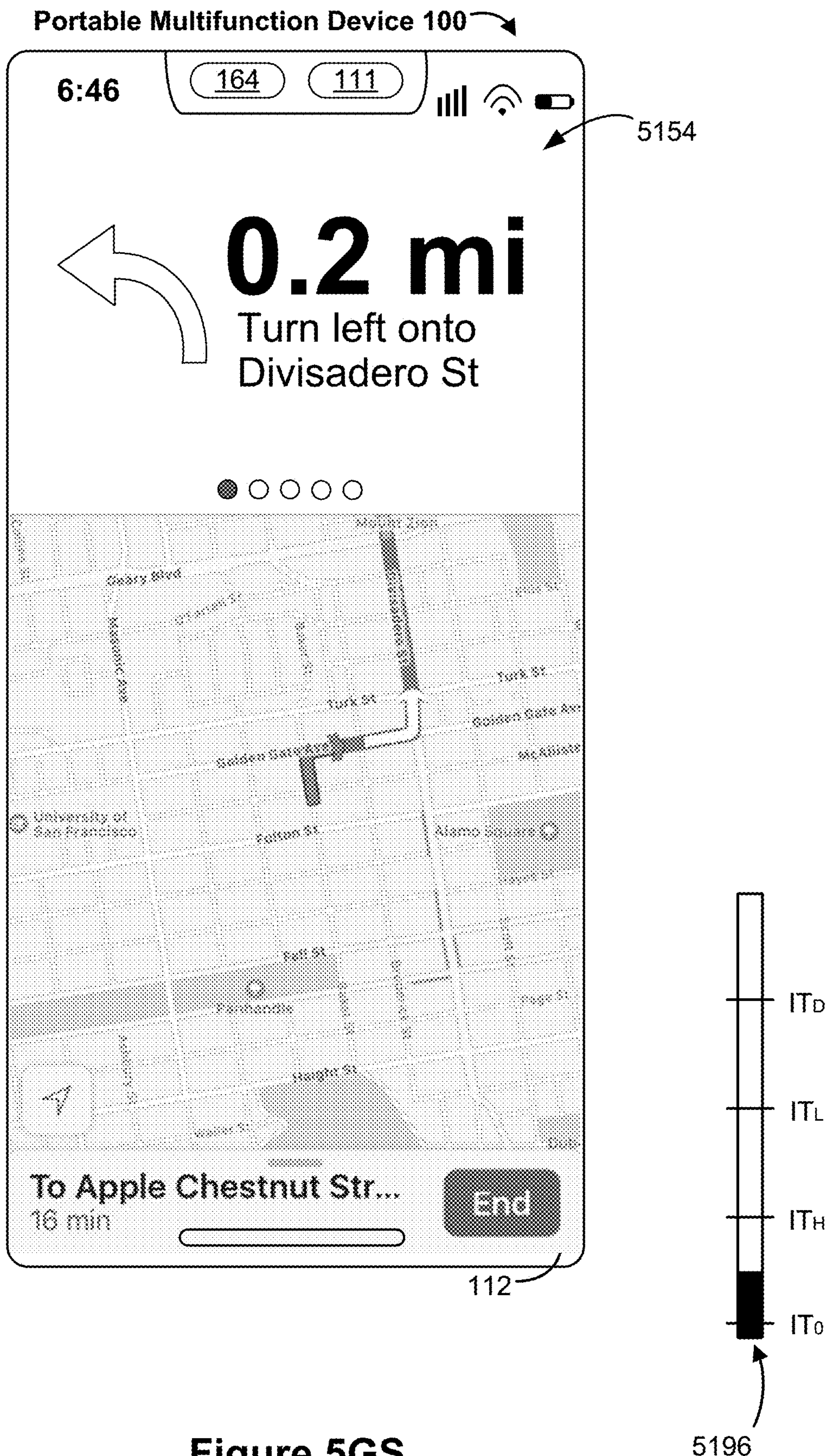

Portable Multifunction Device 100
6:46
164
111
5154
0.2 mi
Turn left onto
Divisadero St
To Apple Chestnut Str...
16 min
End
112
ITD
ITL
ITH
IT0
5196

Figure 5GS

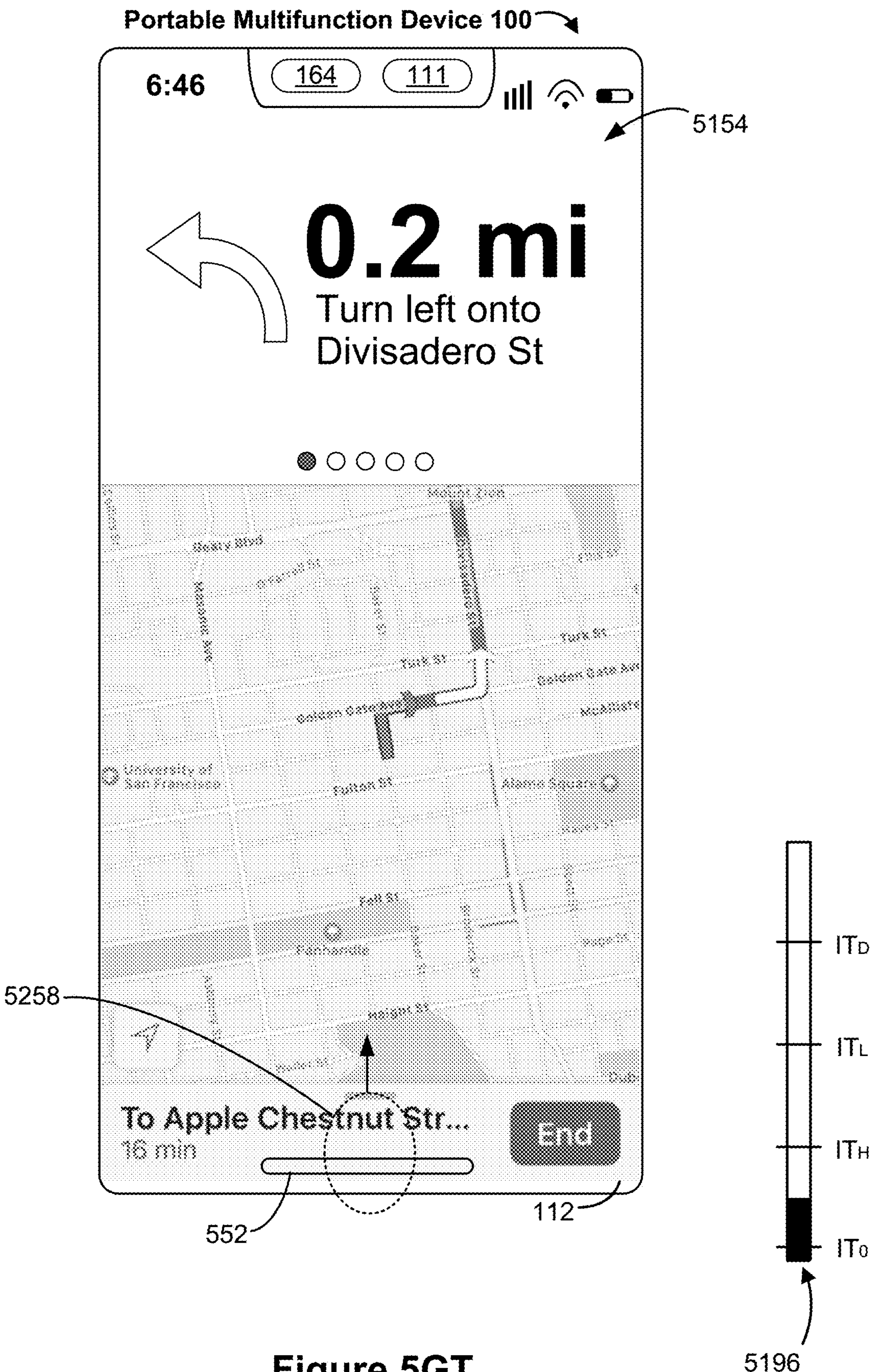
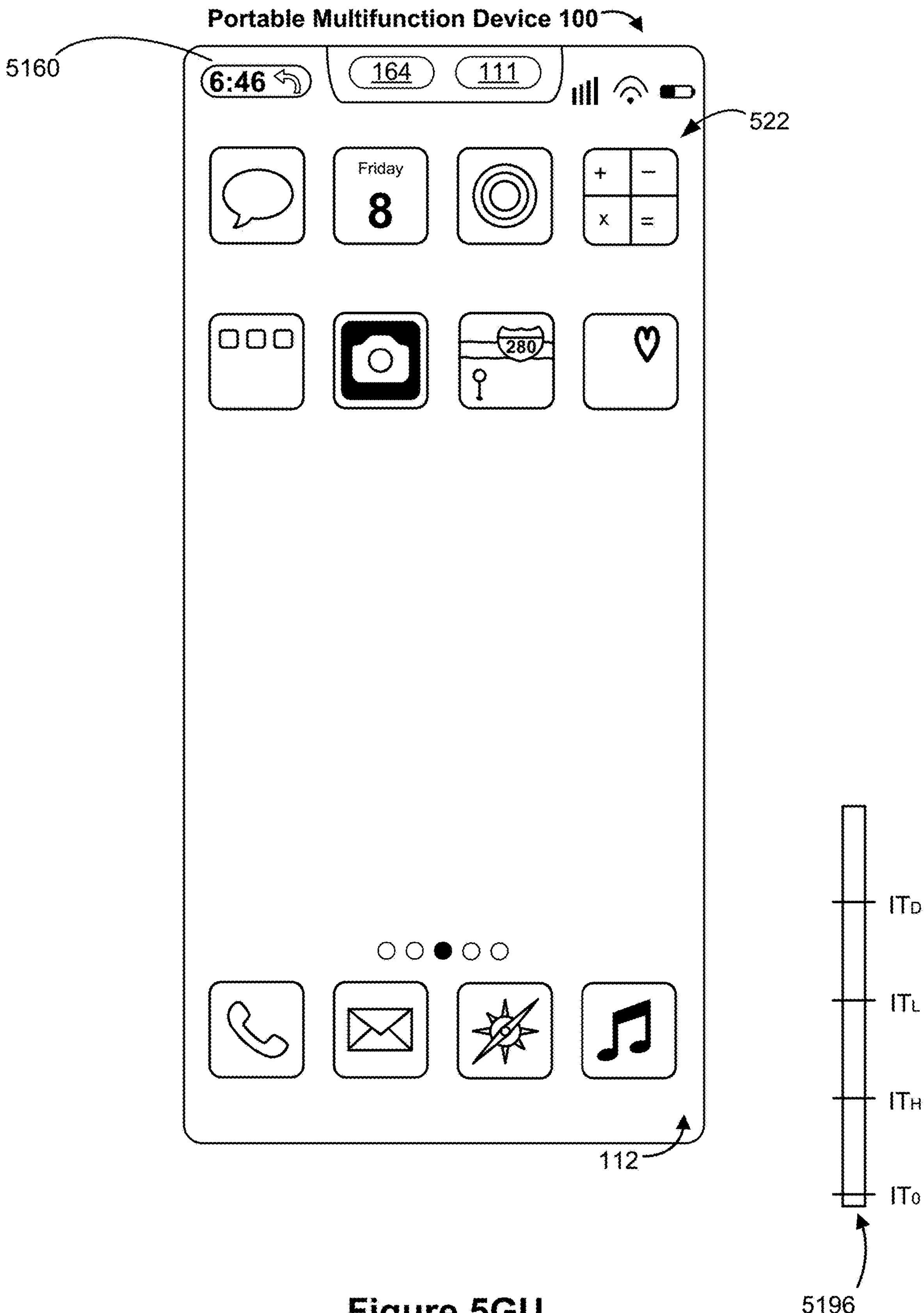
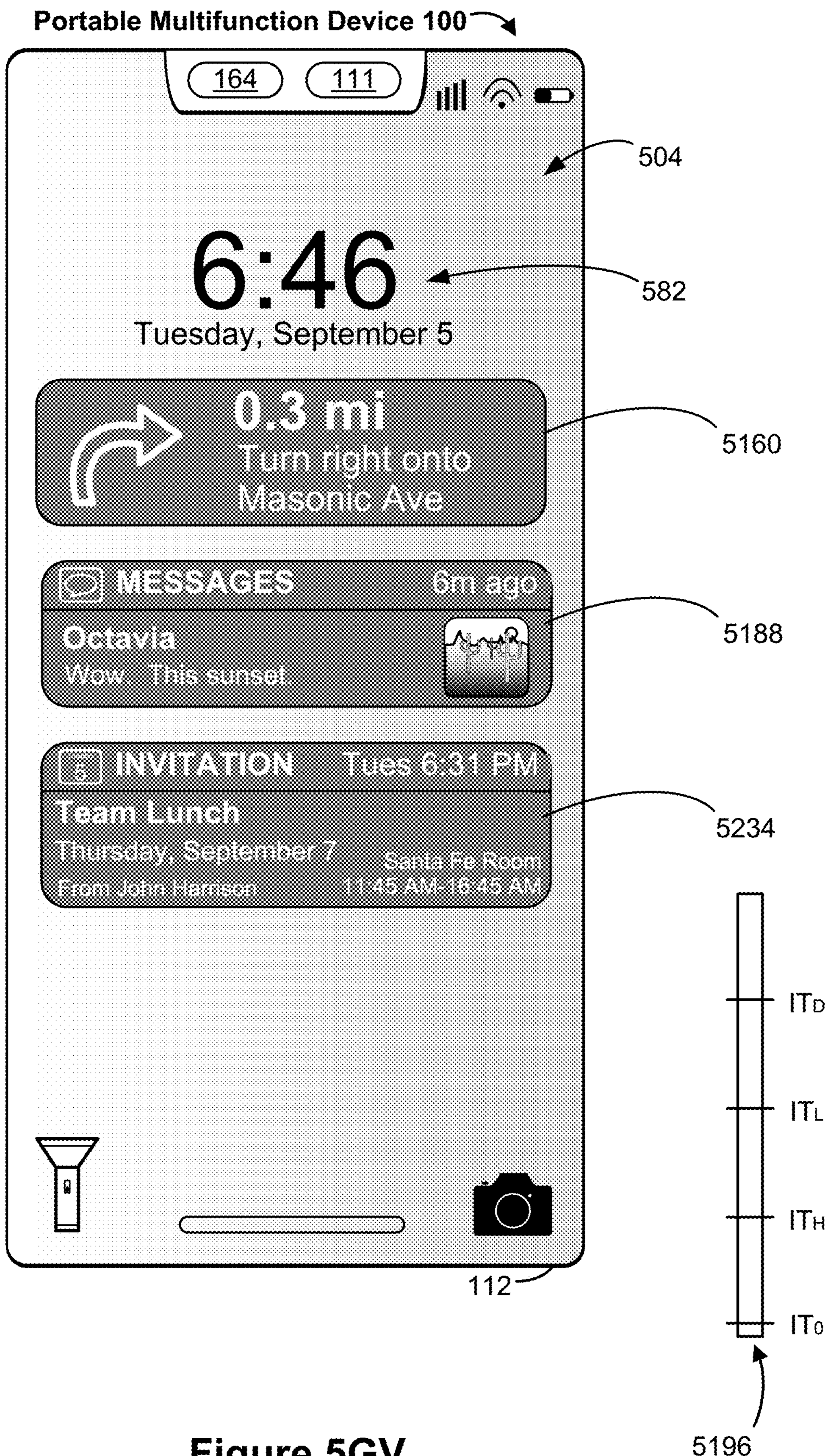

Portable Multifunction Device 100
6:46
164
111
5154
0.2 mi
Turn left onto
Divisadero St
Turk St
Golden Gate Ave
Fulton St
Fell St
Haight St
To Apple Chestnut Str...
16 min
End
5258
552
112
ITD
ITL
ITH
IT0
5196

Figure 5GT



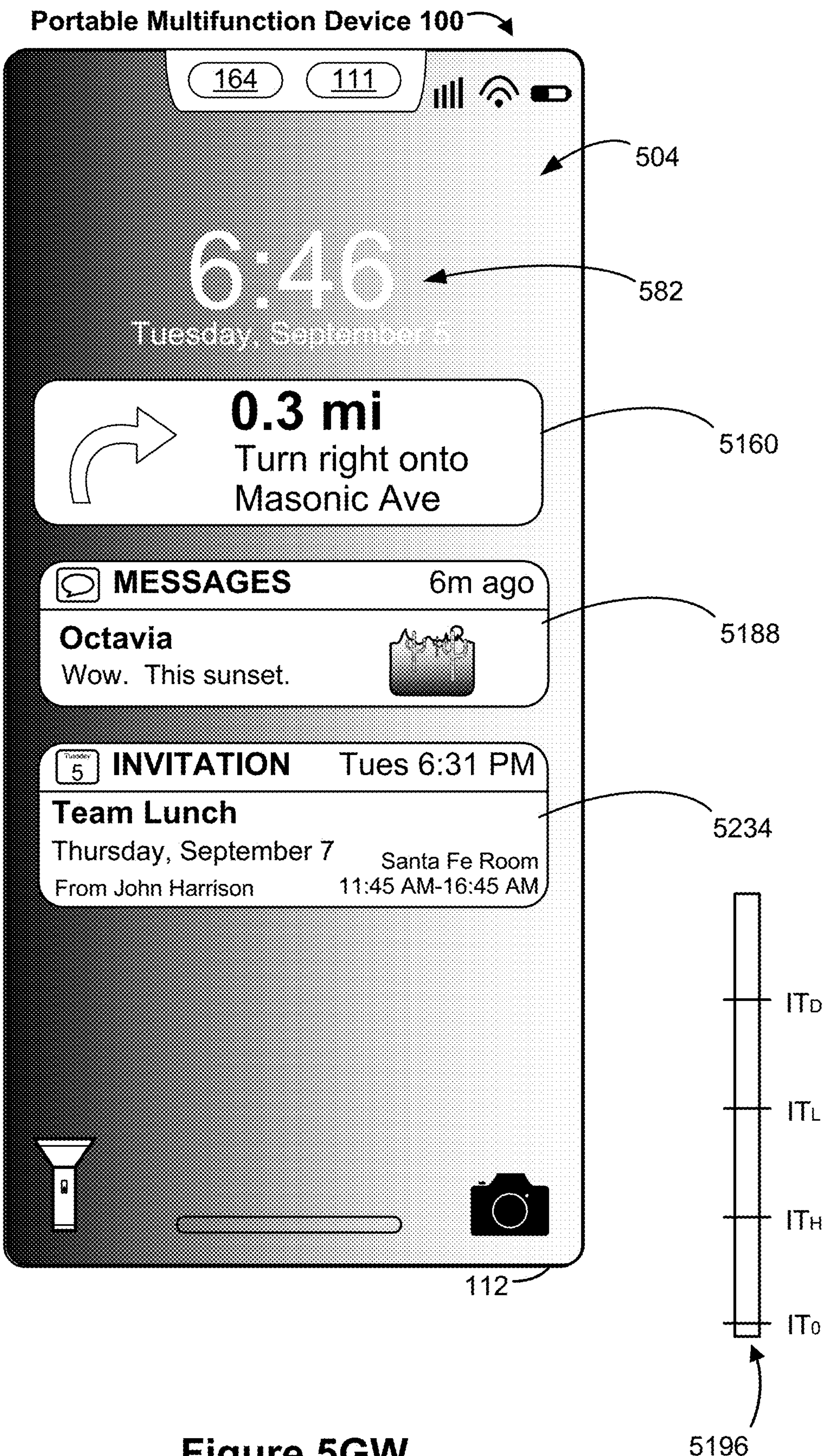
Portable Multifunction Device 100
5160
6:46
164
111
522
Friday
8
+
−
x
=
280
112
IT_D
IT_L
IT_H
IT_0
5196

Figure 5GU



Portable Multifunction Device 100
164
111
504
6:46
Tuesday, September 5
582
0.3 mi
Turn right onto
Masonic Ave
5160
MESSAGES
6m ago
Octavia
Wow. This sunset.
5188
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
From John Harrison
Santa Fe Room
11:45 AM-16:45 AM
5234
IT_D
IT_L
IT_H
IT_0
112
5196

Figure 5GV



Portable Multifunction Device 100
164
111
504
6:46
Tuesday, September 5
582
0.3 mi
Turn right onto
Masonic Ave
5160
MESSAGES
6m ago
Octavia
Wow. This sunset.
5188
5
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
Santa Fe Room
From John Harrison
11:45 AM-16:45 AM
5234
ITD
ITL
ITH
IT0
112
5196

Figure 5GW

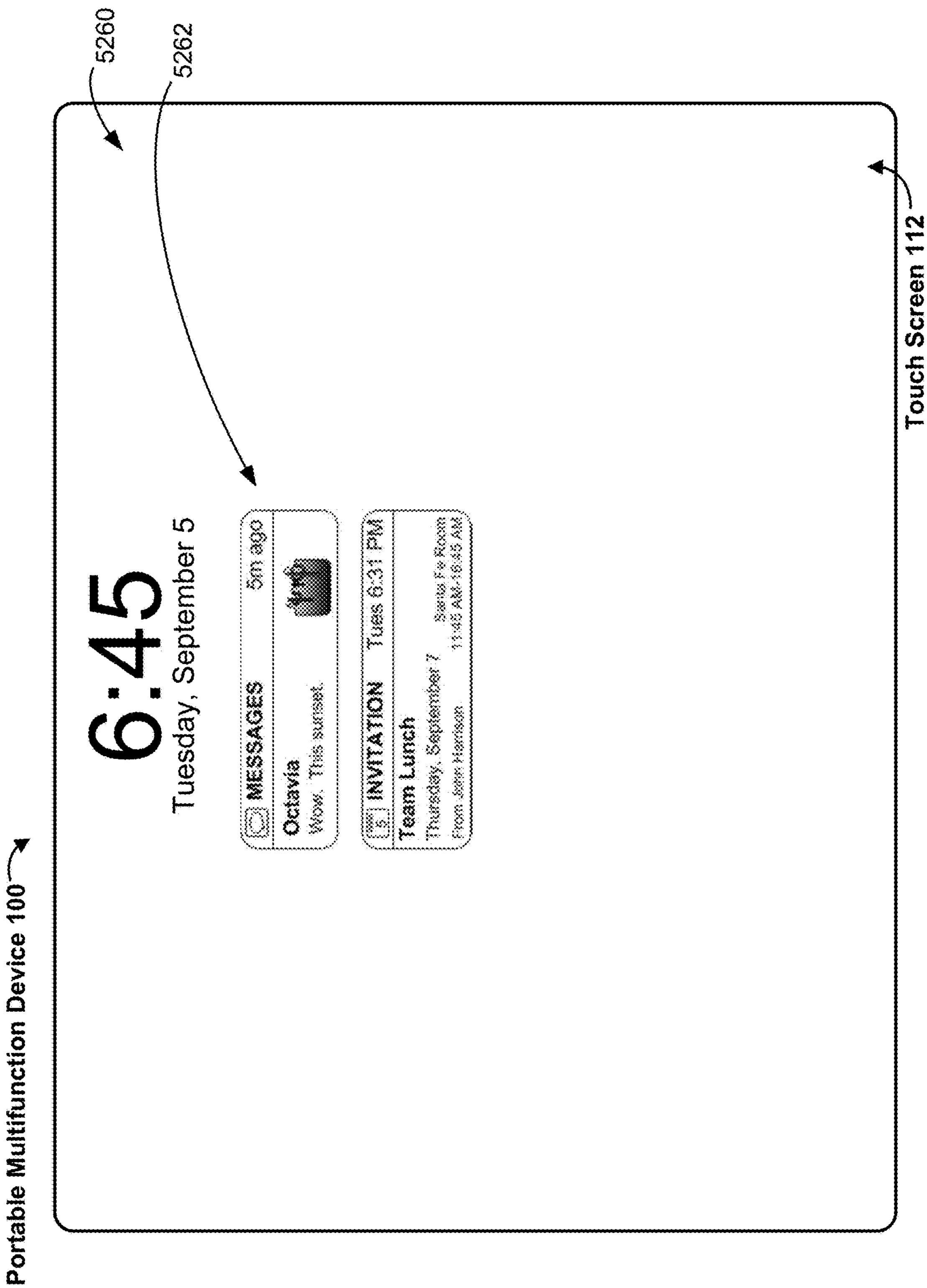

5260
5262
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
Santa Fe Room
Touch Screen 112
Portable Multifunction Device 100

Figure 5GX

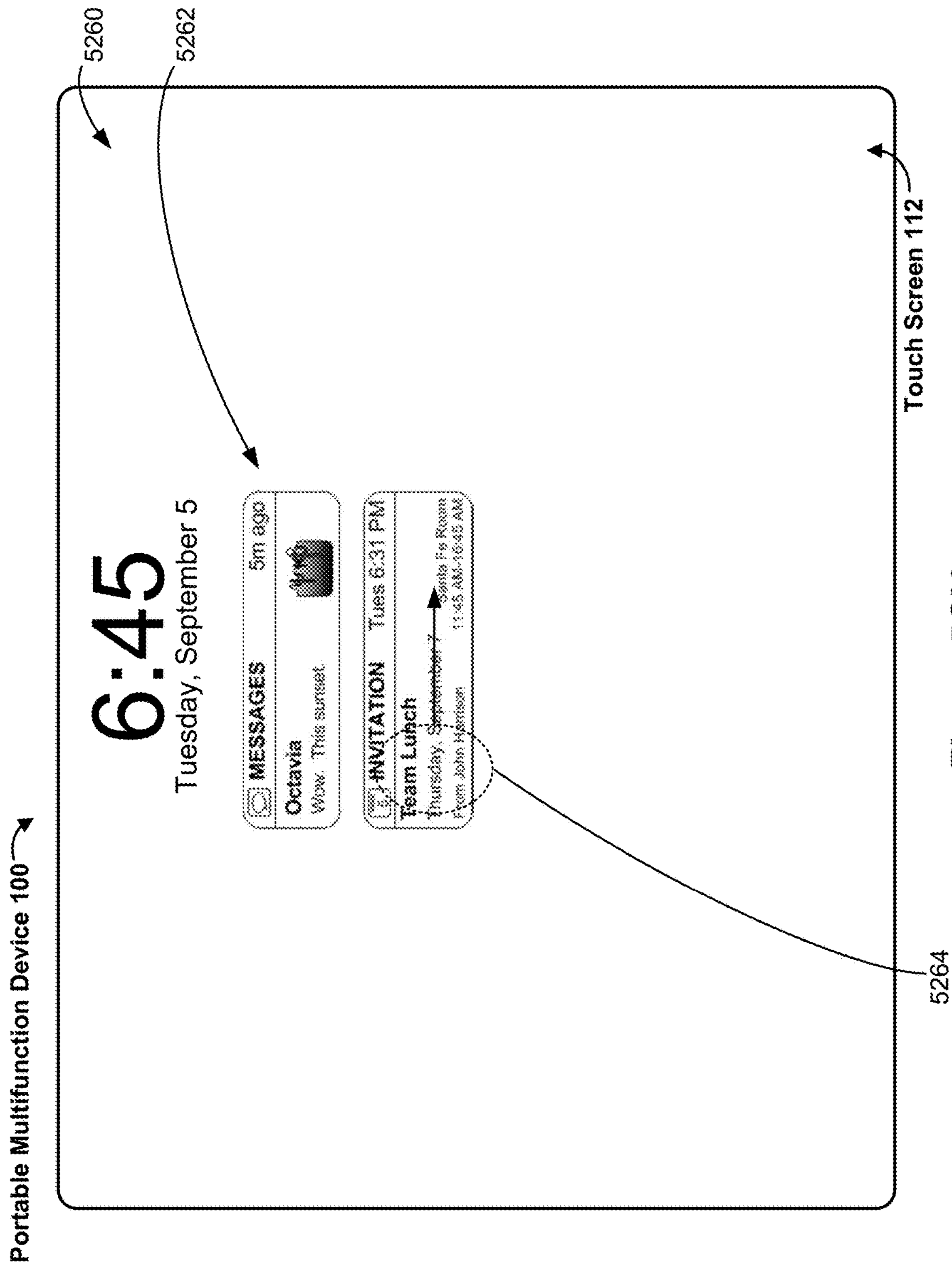

5260
5262
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset
INVITATION
Tues 6:31 PM
Team Lunch
Touch Screen 112
5264
Portable Multifunction Device 100

Figure 5GY

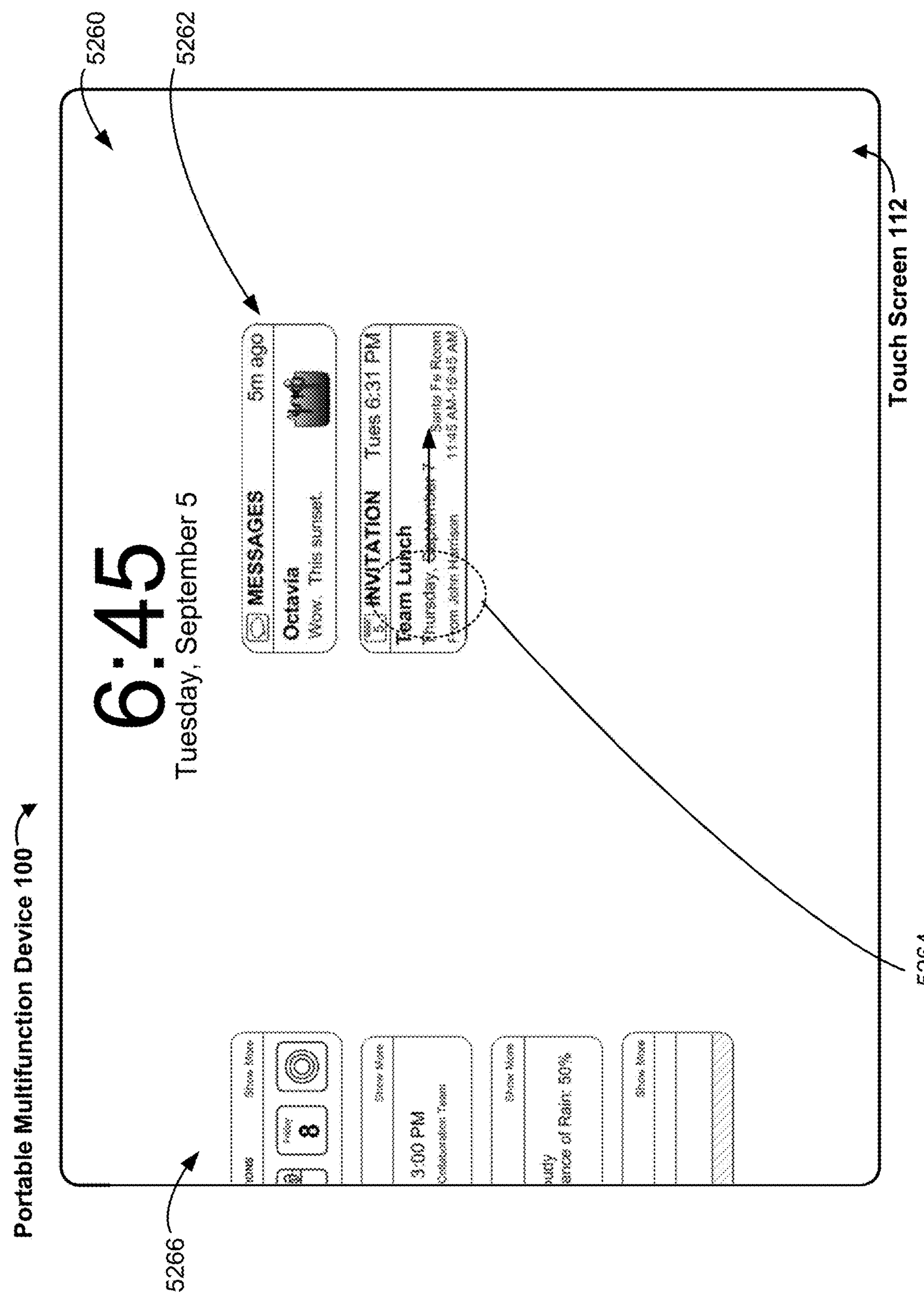

5260
5262
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Touch Screen 112
Portable Multifunction Device 100
5264
5266
3:00 PM
Show More

Figure 5GZ

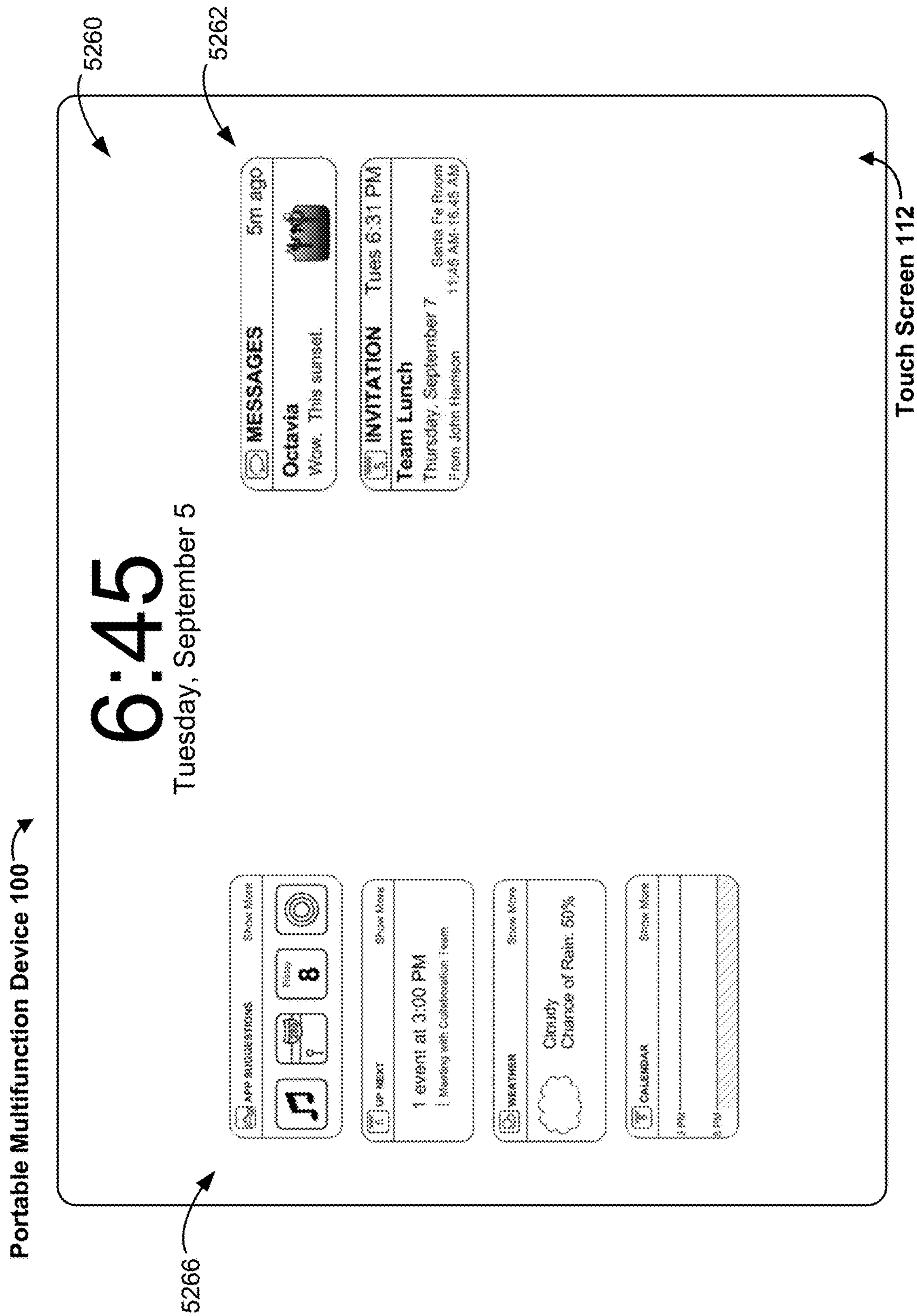

5260
5262
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
INVITATION
Tues 6:31 PM
Team Lunch
1 event at 3:00 PM
Cloudy
Chance of Rain: 50%
Touch Screen 112
Portable Multifunction Device 100
5266

Figure 5HA

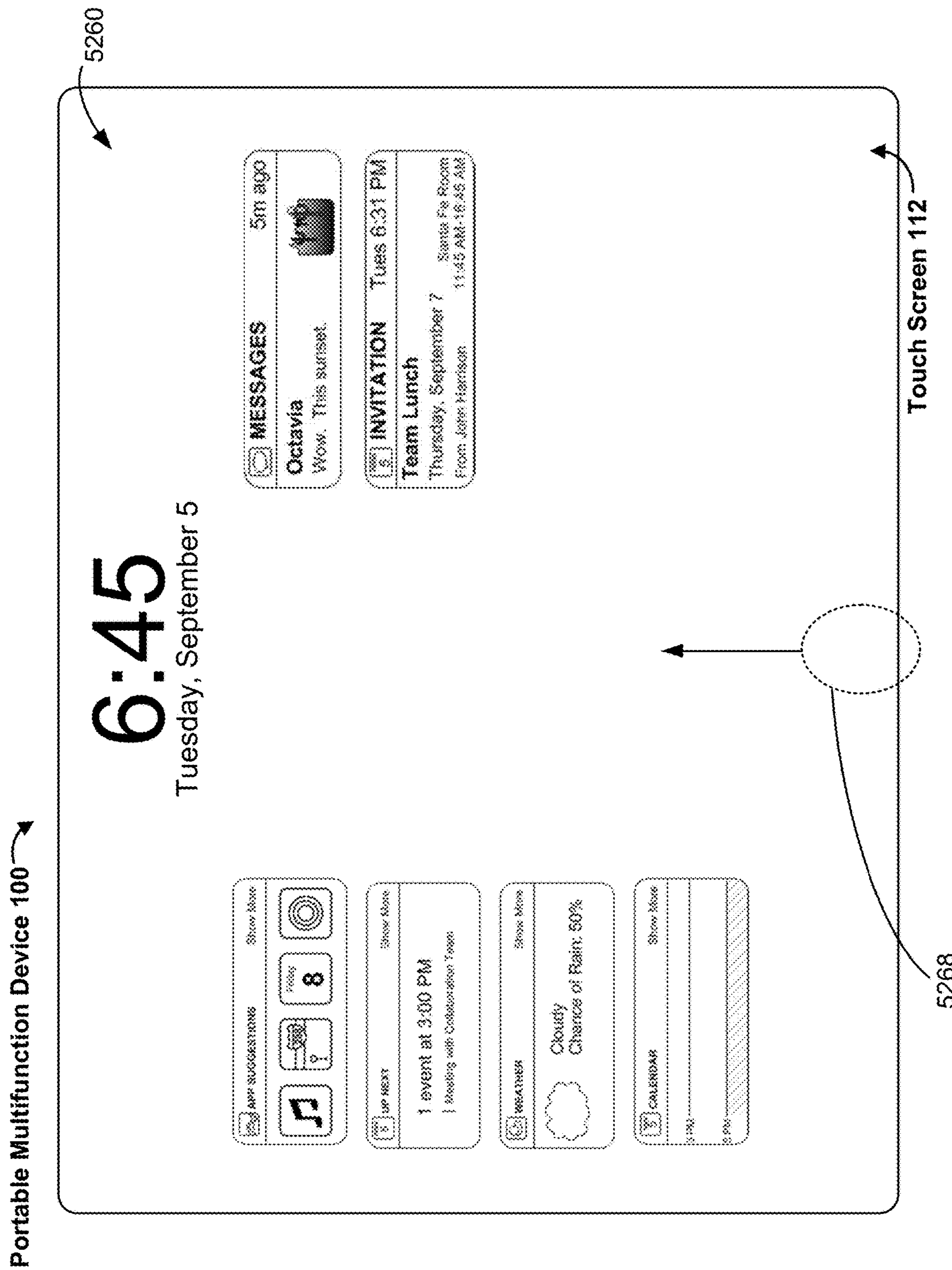

Portable Multifunction Device 100
5260
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
1 event at 3:00 PM
Cloudy
Chance of Rain: 50%
Touch Screen 112
5268

Figure 5HB

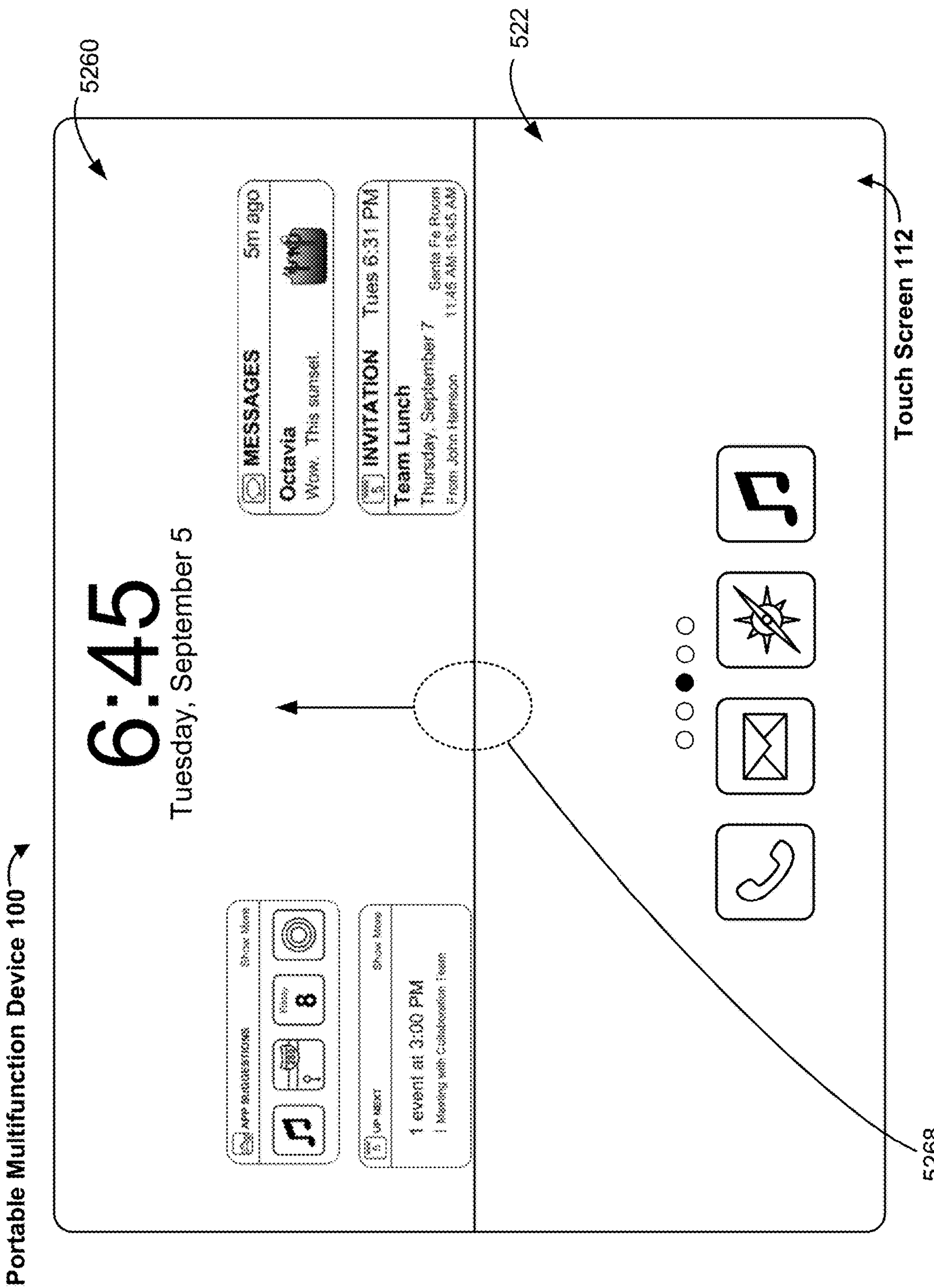

Portable Multifunction Device 100
5260
522
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
1 event at 3:00 PM
Touch Screen 112
5268

Figure 5HC

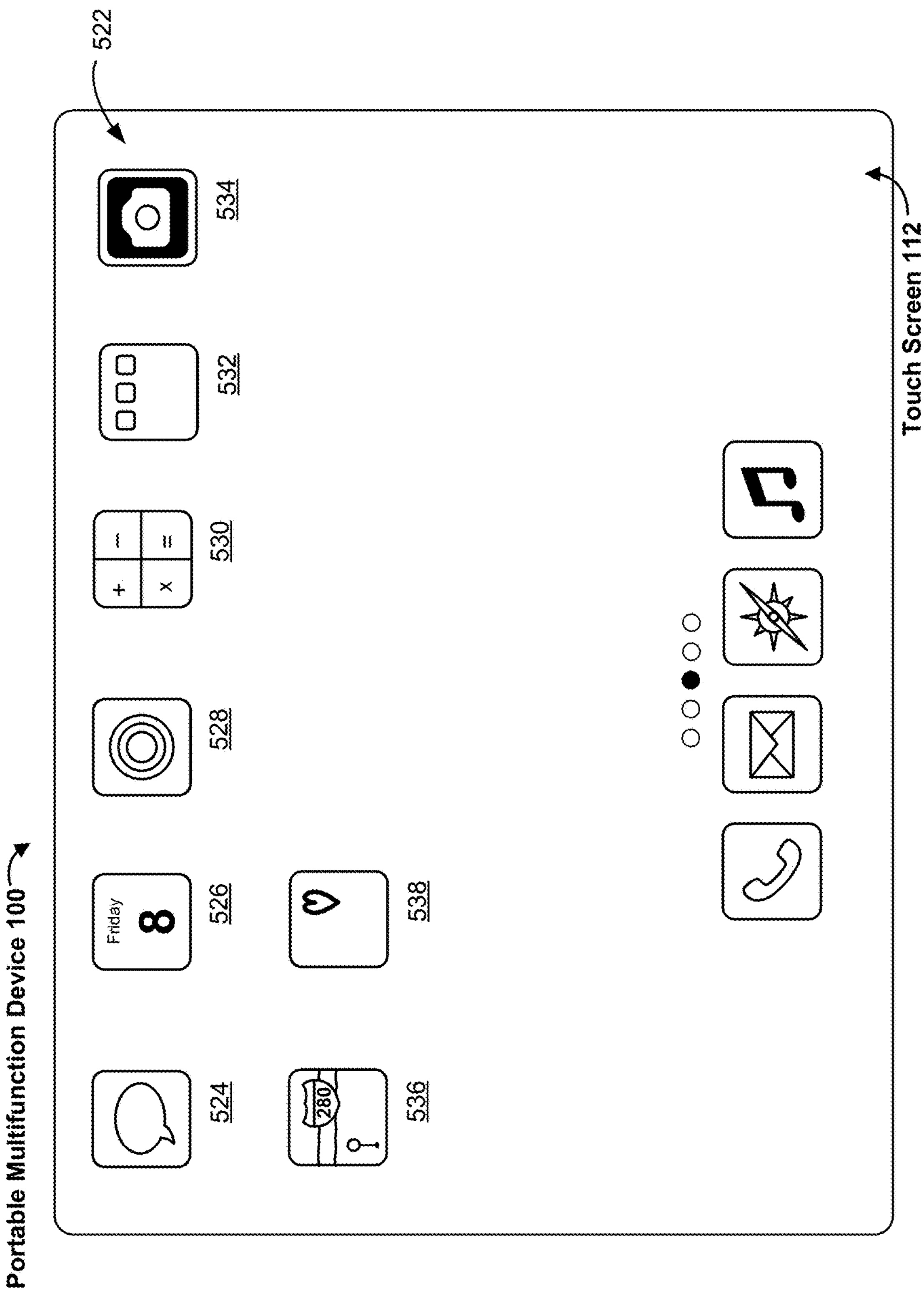
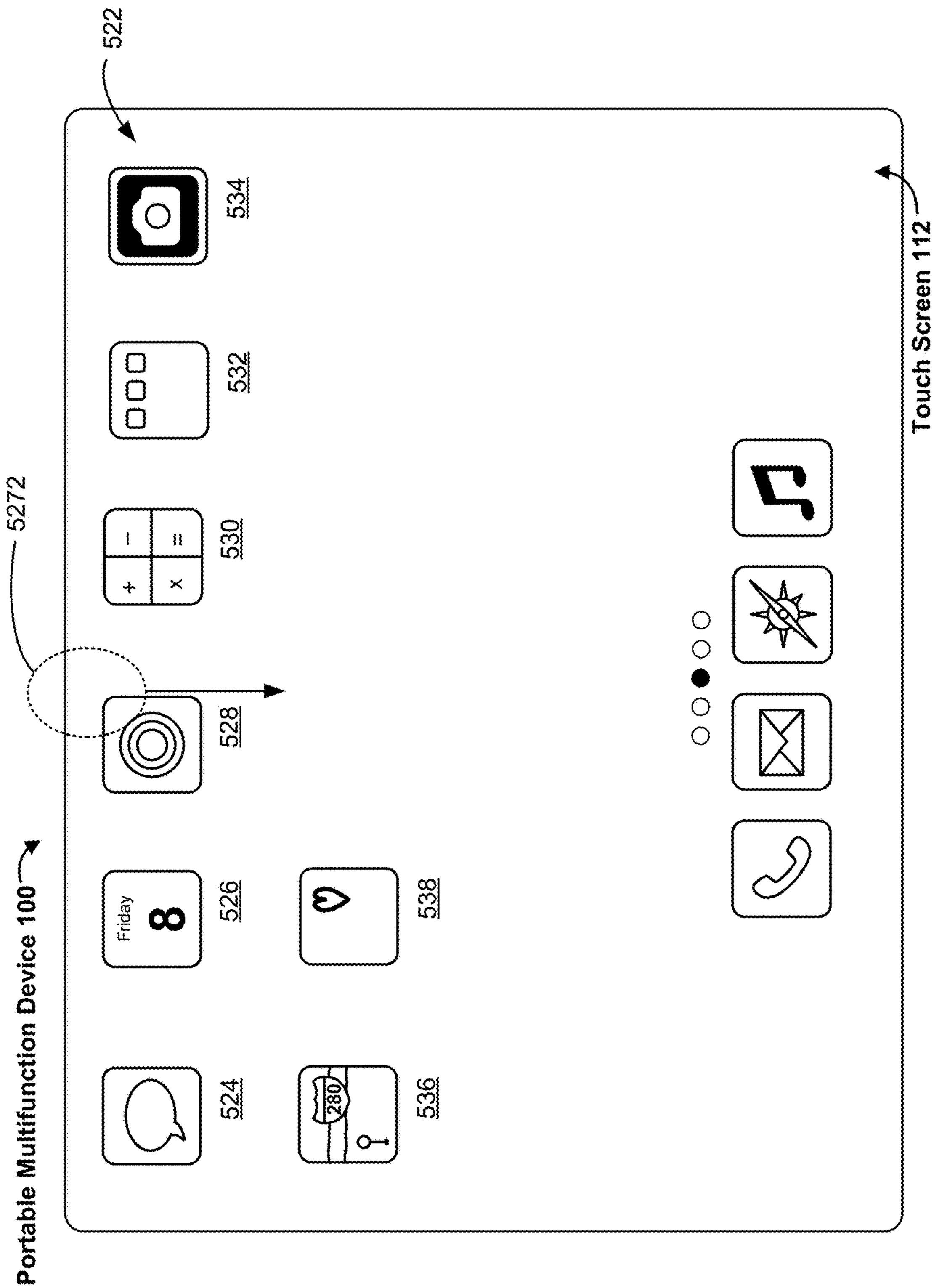

522
534
532
530
528
526
538
524
536
Friday
8
280
Touch Screen 112
Portable Multifunction Device 100

Figure 5HD



522
5272
Portable Multifunction Device 100
Touch Screen 112
534
532
530
528
526
524
538
536
Friday
8
280

Figure 5HE

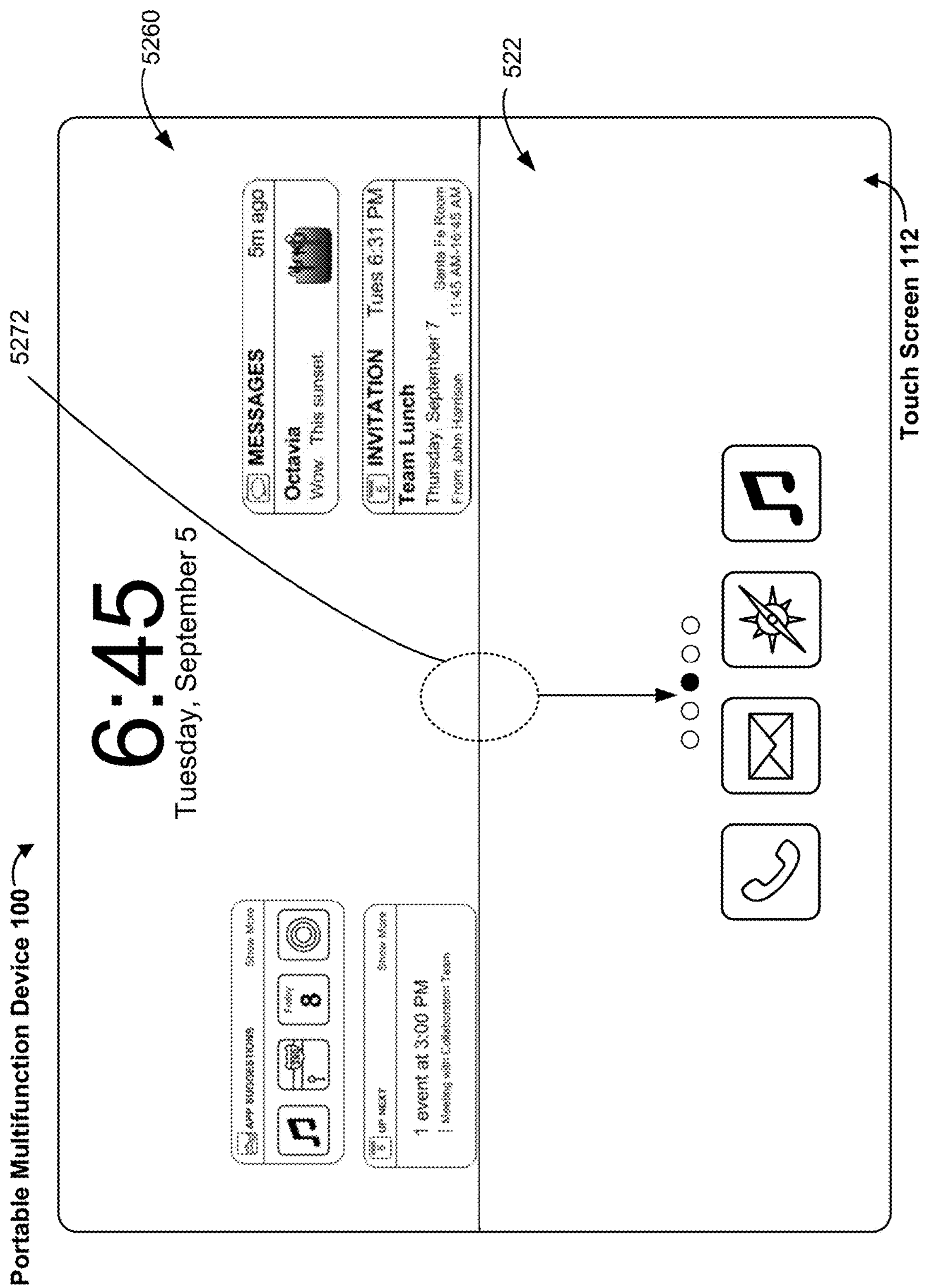

Portable Multifunction Device 100
5272
5260
522
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
From John Harrison
1 event at 3:00 PM
Touch Screen 112

Figure 5HF

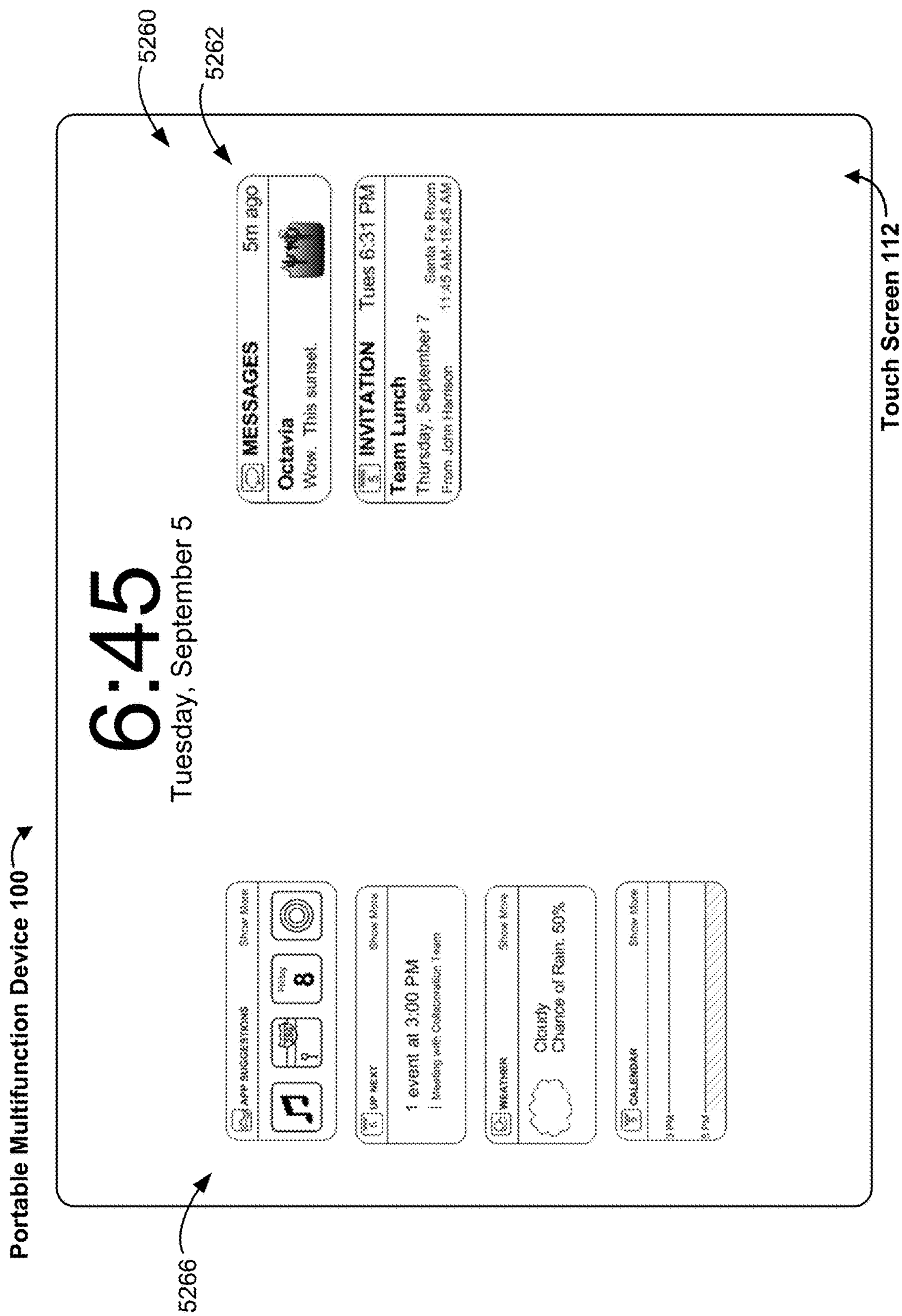
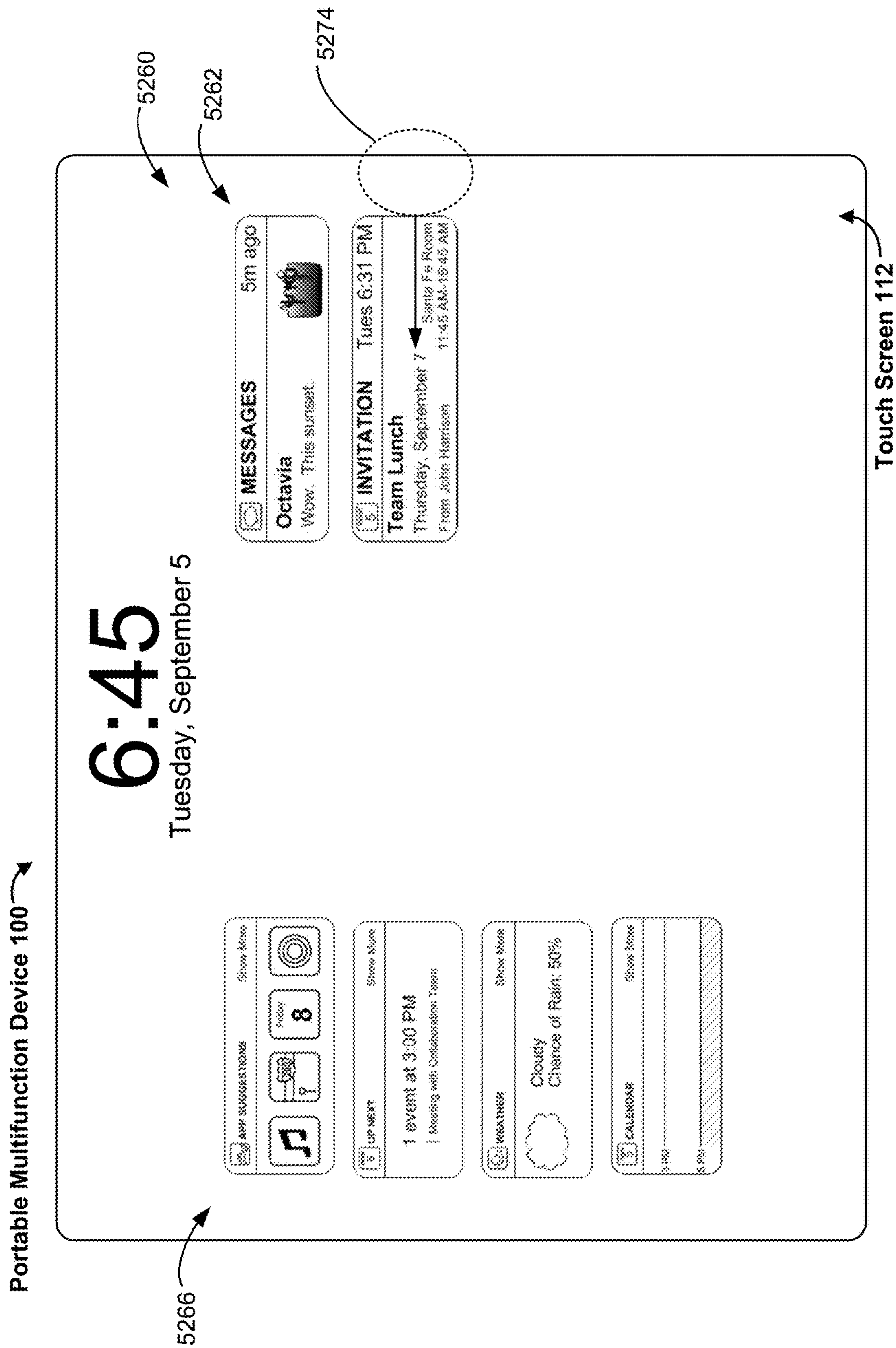

Portable Multifunction Device 100
5260
5262
5266
Touch Screen 112
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
From John Harrison
1 event at 3:00 PM
Cloudy
Chance of Rain: 50%

Figure 5HG



Portable Multifunction Device 100
5260
5262
5274
5266
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
From John Harrison
Touch Screen 112
1 event at 3:00 PM
Cloudy
Chance of Rain: 50%

Figure 5HH

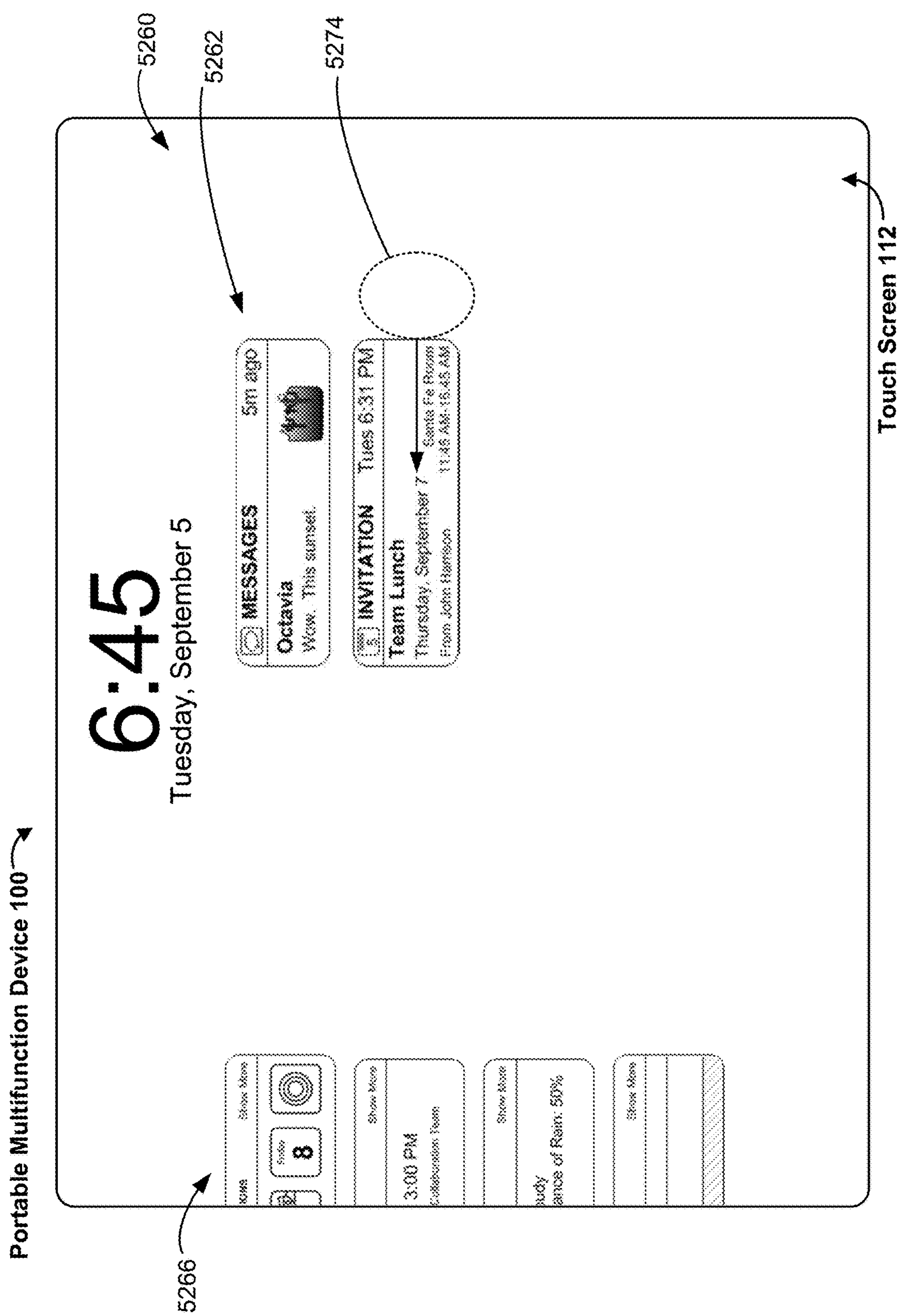
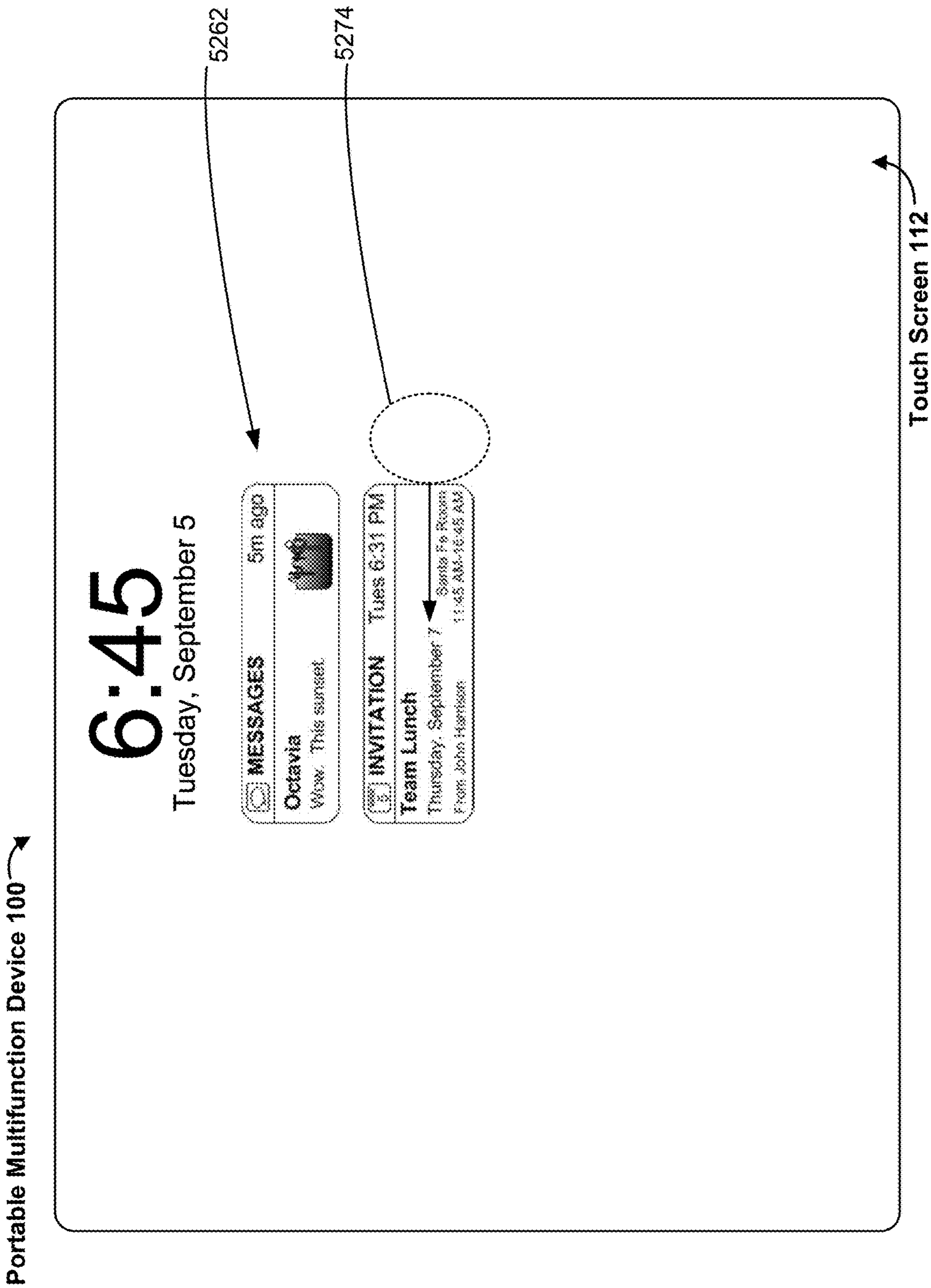

Portable Multifunction Device 100
5260
5262
5274
5266
Touch Screen 112
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
From John Harrison
3:00 PM

Figure 5HI



5262
5274
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
From John Harrison
Santa Fe Room
11:45 AM–12:45 AM
Touch Screen 112
Portable Multifunction Device 100

Figure 5HJ

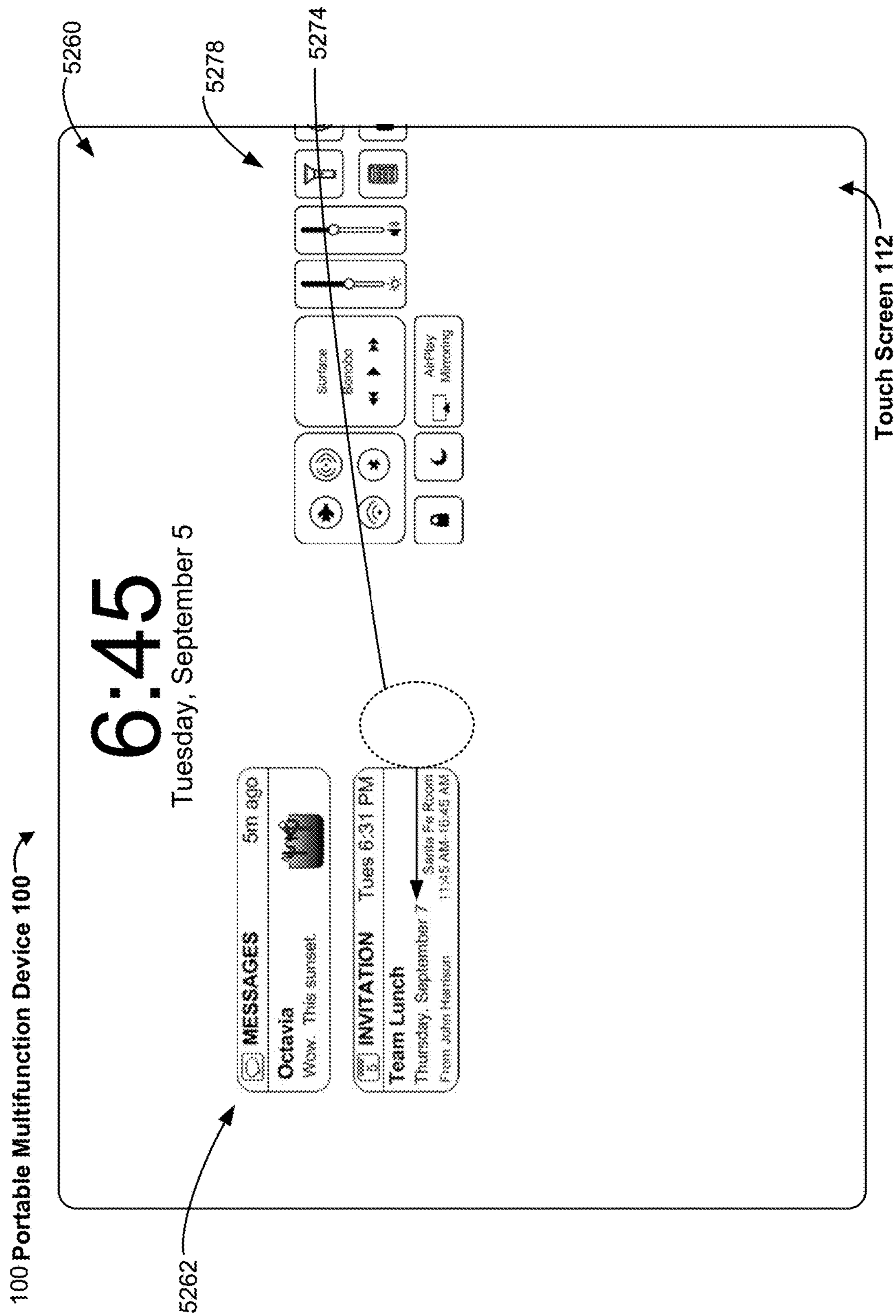

5260
5278
5274
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
Touch Screen 112
100 Portable Multifunction Device 100
5262

Figure 5HK

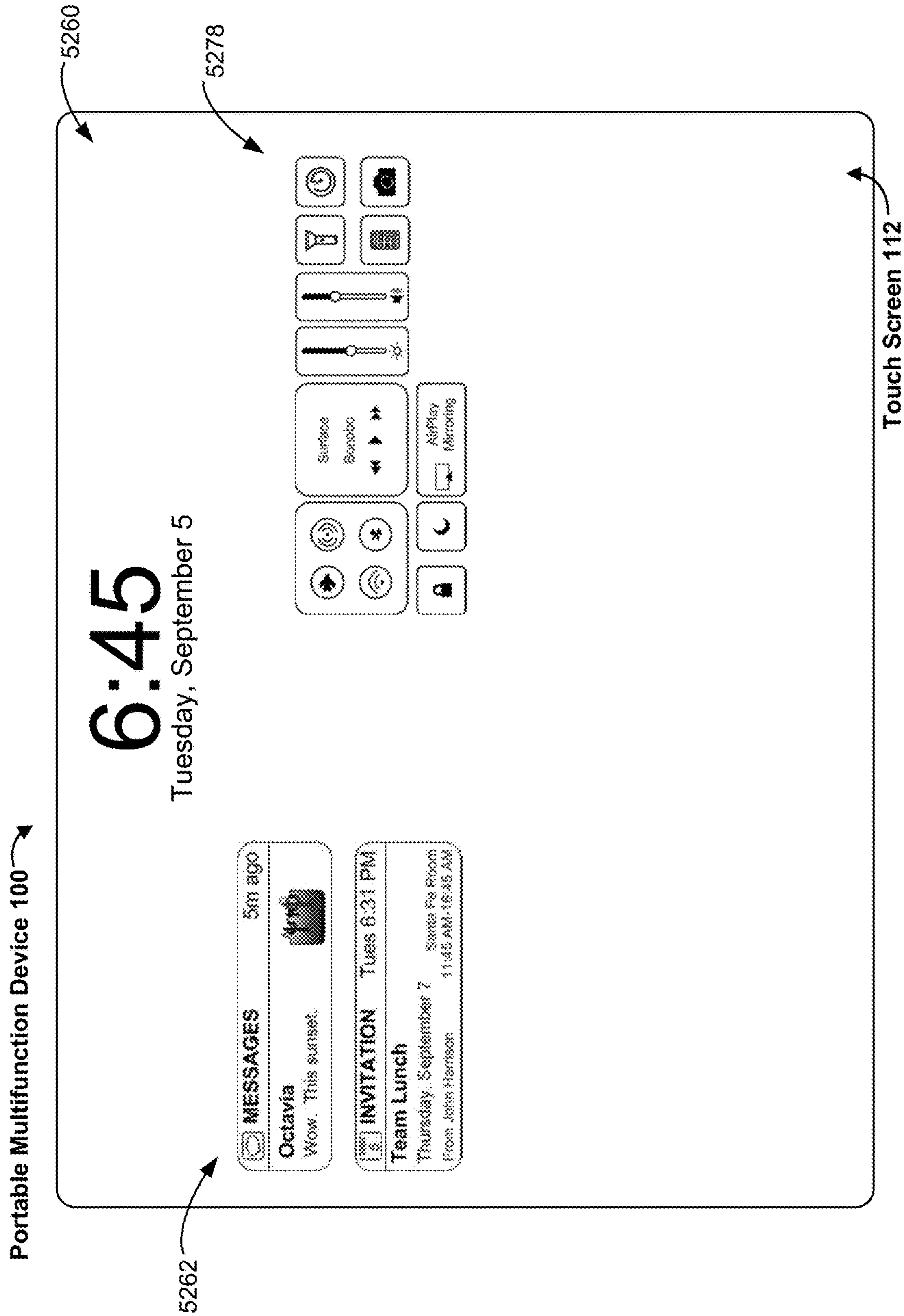

Portable Multifunction Device 100
5260
5278
5262
Touch Screen 112
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7

Figure 5HL

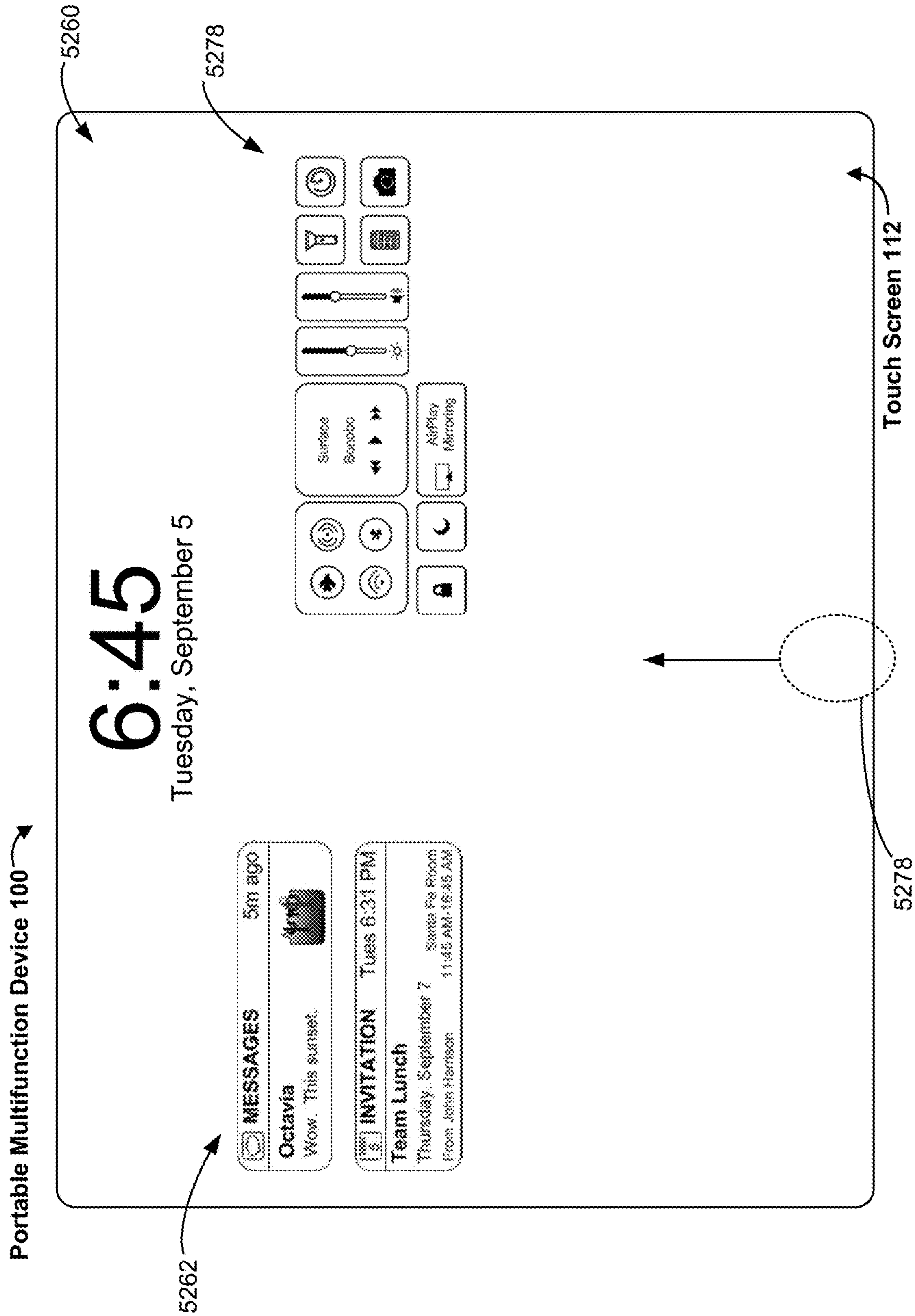

Portable Multifunction Device 100
5260
5278
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
AirPlay Mirroring
Touch Screen 112
5278
5262

Figure 5HM

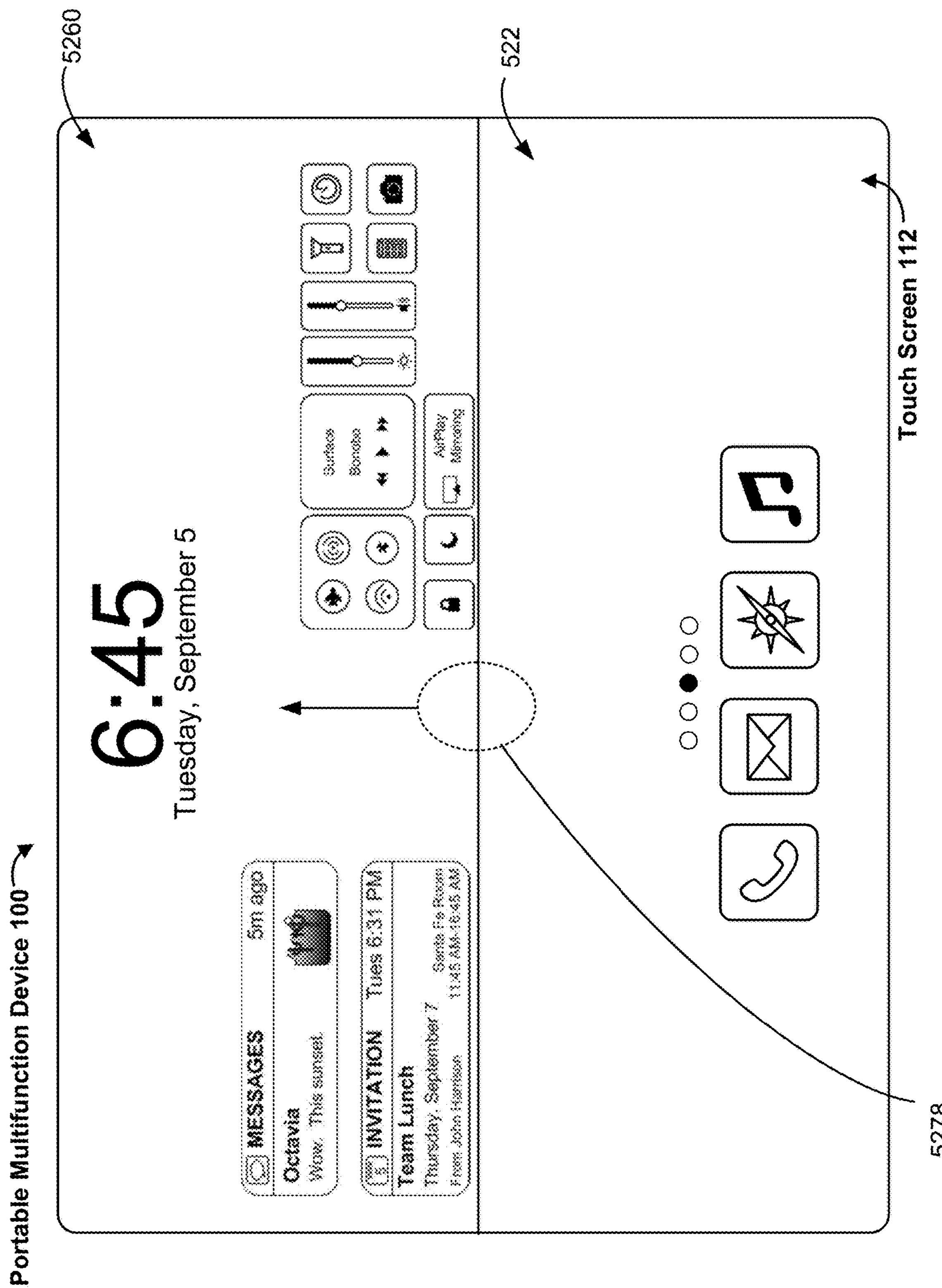

5260
522
Portable Multifunction Device 100
Touch Screen 112
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
AirPlay Mirroring
5278

Figure 5HN

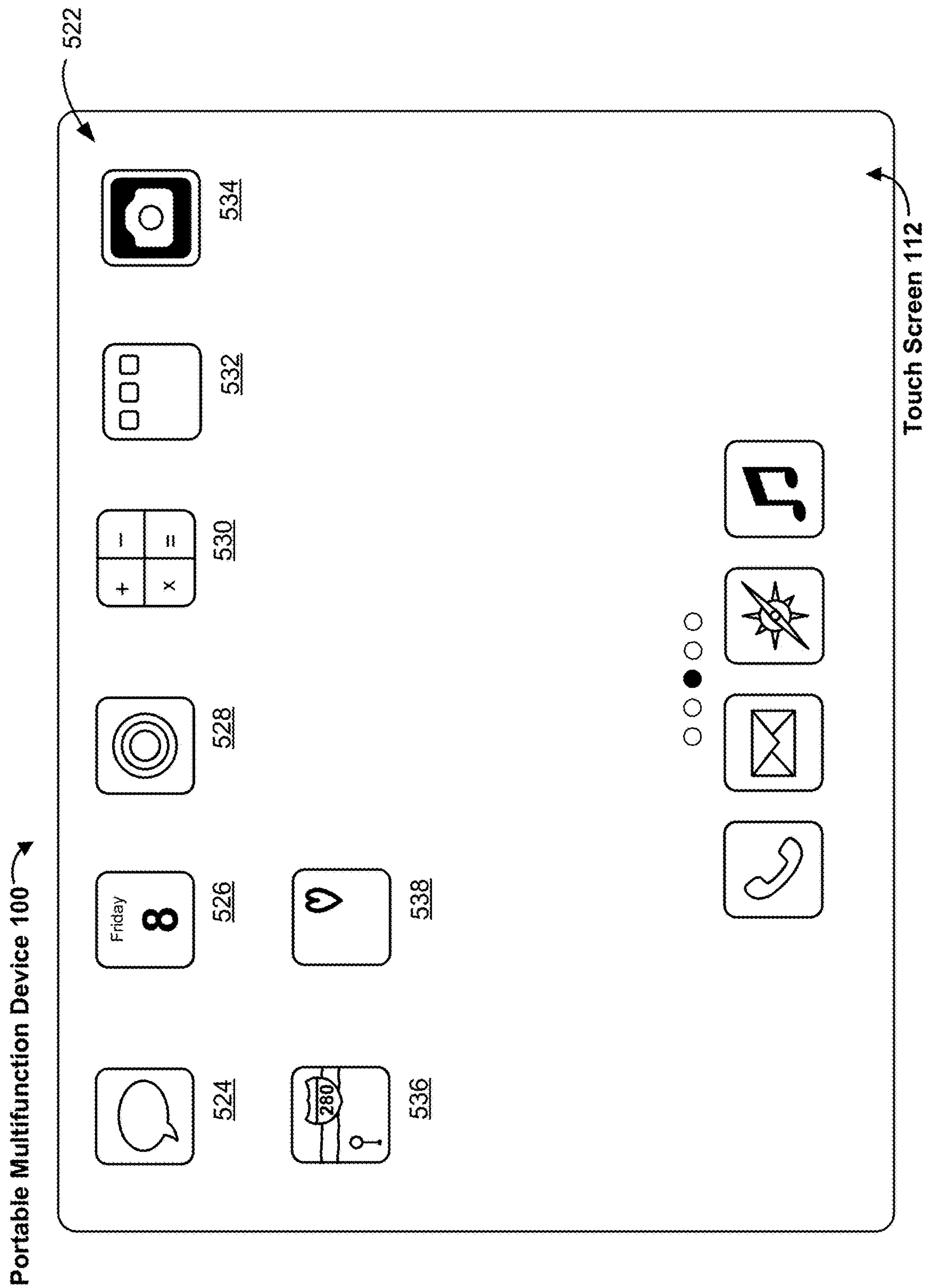

522
Portable Multifunction Device 100
Touch Screen 112
534
532
530
528
526
524
538
536
Friday
8
280
+
−
×
=

Figure 5HO

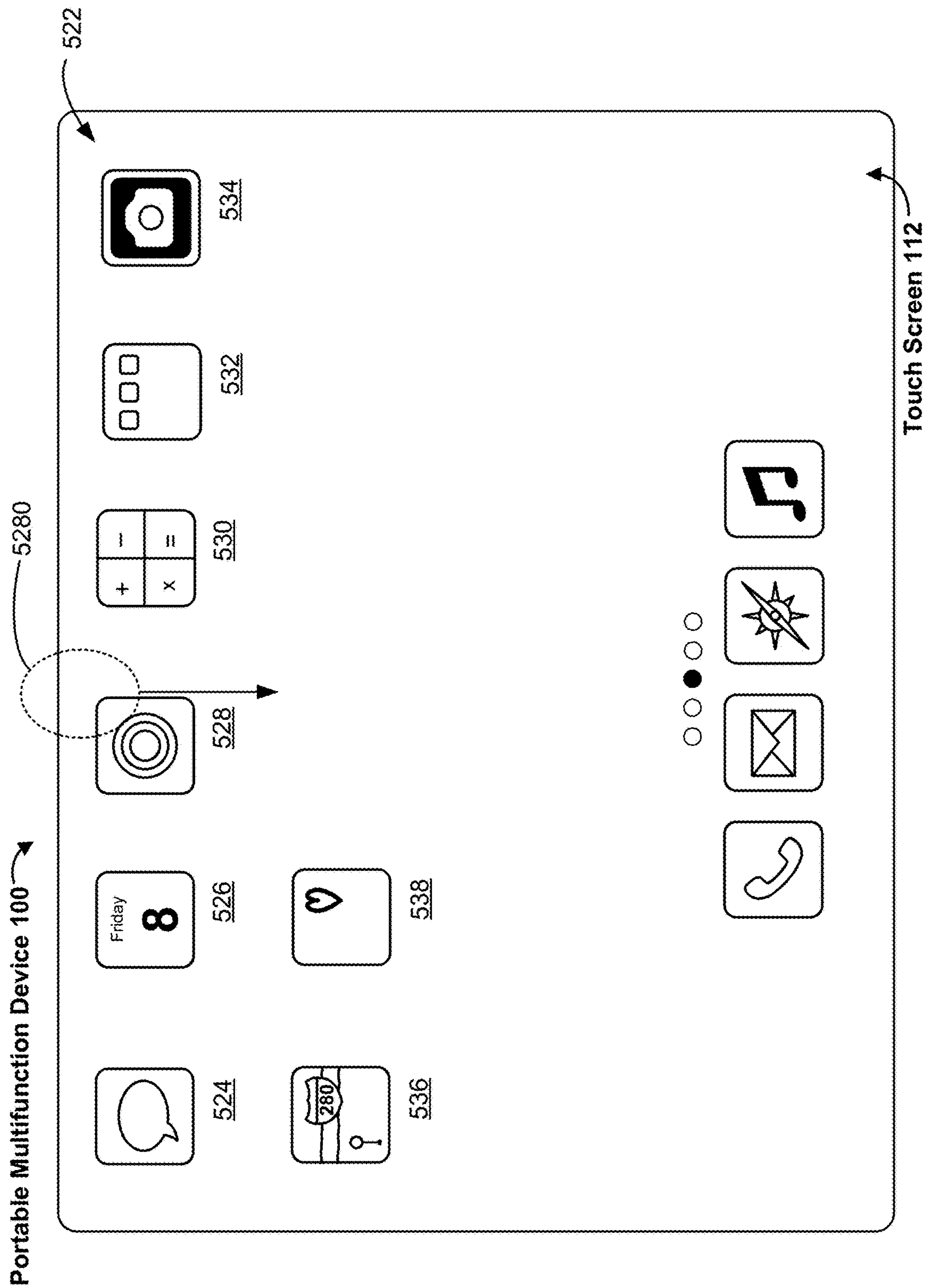

Portable Multifunction Device 100
522
5280
Touch Screen 112
534
532
530
528
526
524
538
536
Friday
8
280

Figure 5HP

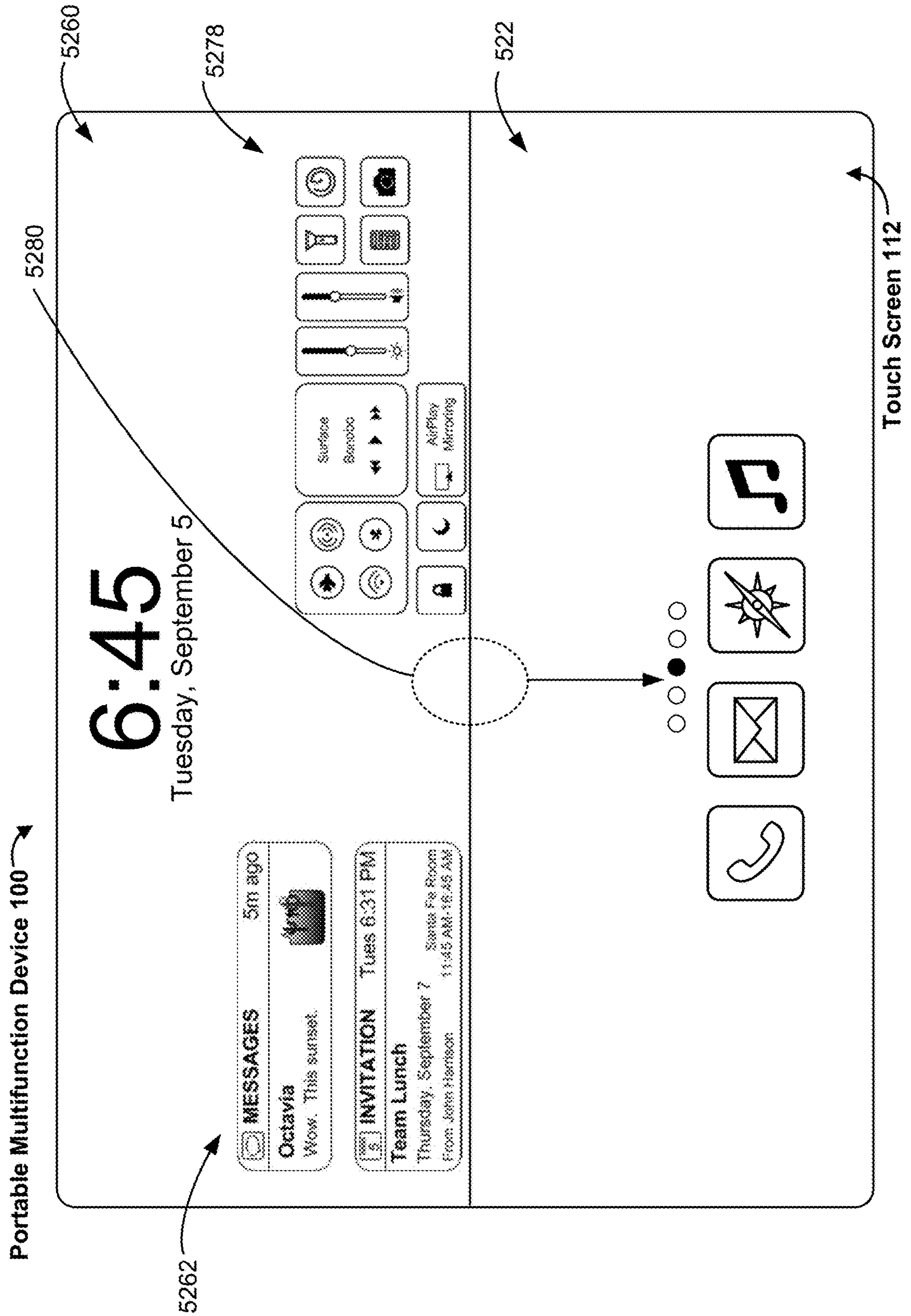

5260
5278
522
5280
Touch Screen 112
Portable Multifunction Device 100
5262
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7

Figure 5HQ

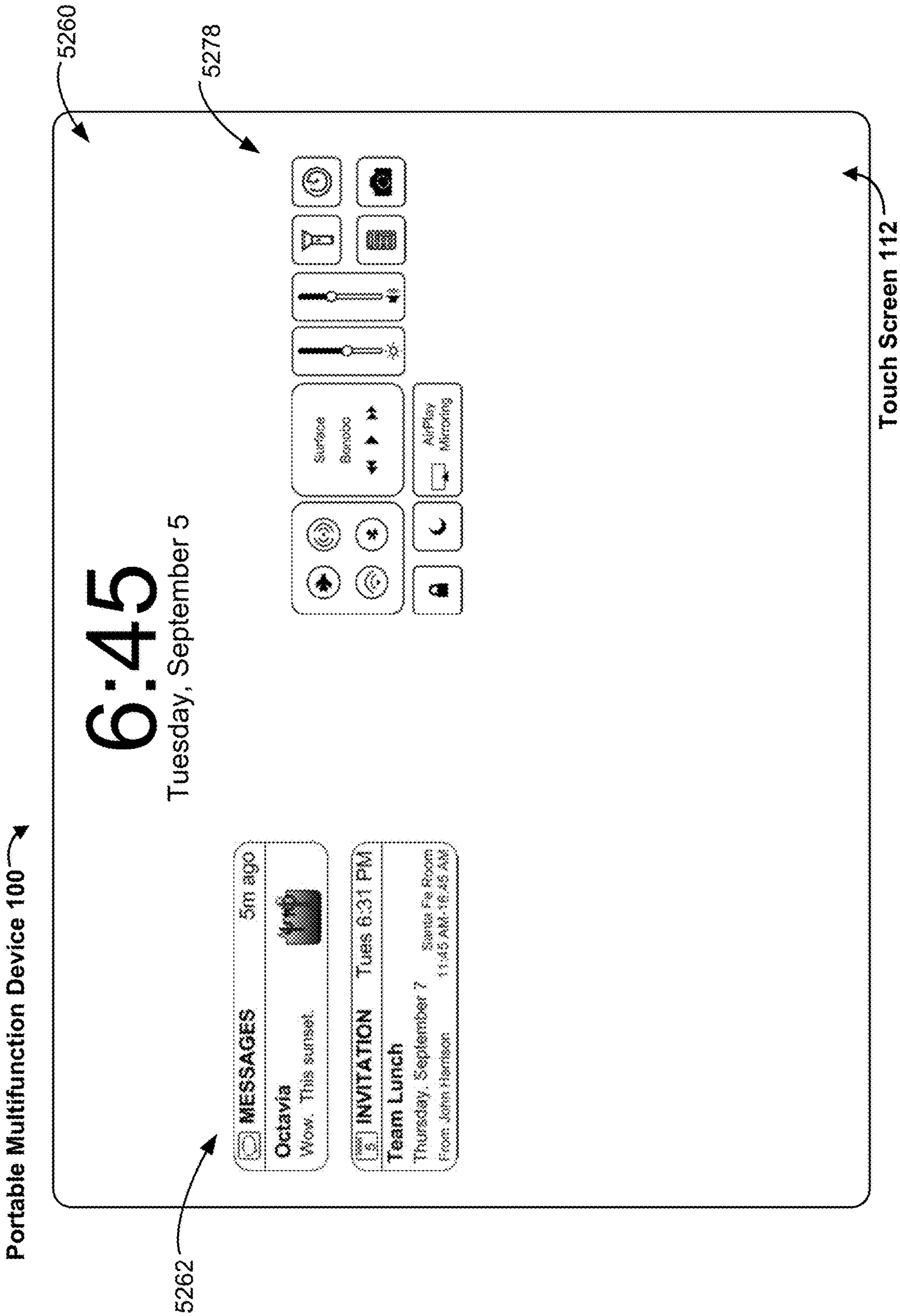

Portable Multifunction Device 100
5260
5278
5262
Touch Screen 112
6:45
Tuesday, September 5
MESSAGES
5m ago
Octavia
Wow. This sunset.
INVITATION
Tues 6:31 PM
Team Lunch
Thursday, September 7
Surface
Bonobo
AirPlay Mirroring

Figure 5HR

600

602 While the device is in a screen-off state, receive one or more notifications

↓

604 After receiving the one or more notifications, detect a first input from a user for waking the device from the screen-off state to a screen-on state

↓

606 In response to detecting the first input for waking the device from the screen-off state to the screen-on state:
- transition the device from the screen-off state to the screen-on state;
- display a wake screen user interface on the display; and
- display the one or more notifications on the wake screen user interface

↓

608 While displaying the wake screen user interface and while at least one of the one or more notifications remains displayed on the wake screen user interface, detect a second input for dismissing the wake screen user interface

↓

610 In response to detecting the second input for dismissing the wake screen user interface, cease to display the wake screen user interface and the at least one of the one or more notifications

↓

612 After ceasing to display the wake screen user interface and the at least one of the one or more notifications in response to the second input, detect a third input for redisplaying the wake screen user interface

↓

A

Figure 6A

600

A

614 In response to detecting the third input for redisplaying the wake screen user interface:

in accordance with a determination that the third input meets notification-clearance criteria, wherein the notification-clearance criteria require that the third input is detected at a time that is (1) after a respective notification of the one or more notifications has been cleared through direct user interaction with the respective notification or an application that corresponds to the respective notification and (2) after the device has transitioned from the screen-on state to the screen-off state at least once since the detection of the second input, redisplay the wake screen user interface without displaying the at least one of the one or more notifications on the redisplayed wake screen user interface; and

in accordance with a determination that the third input does not meet the notification-clearance criteria:

redisplay the wake screen user interface, and

redisplay the at least one of the one or more notifications on the redisplayed wake screen user interface

616 In response to detecting the third input for redisplaying the wake screen user interface, and in accordance with the determination that the third input does not meet the notification-clearance criteria:

in accordance with a determination that one or more notification-clearance interactions have occurred, forgo display of one or more notifications that are cleared by the one or more notification-clearance interactions on the redisplayed wake screen user interface

B

Figure 6B

600

B

618 After detecting the first input for waking the device from the screen-off state to the screen-on state and prior to detecting the second input for dismissing the wake screen user interface:
detect a plurality of intermediate inputs, the plurality of intermediate inputs including:
a first intermediate input for dismissing the wake screen user interface, and
a second intermediate input for redisplaying the wake screen user interface

620 The second input for dismissing the wake screen user interface is an input for displaying a first user interface that is distinct from the wake screen user interface,
the first user interface is displayed in response to the second input, and
the third input for redisplaying the wake screen user interface was received while the first user interface is displayed

622 The third input for redisplaying the wake screen user interface is received while a content playback application is active, and
redisplaying the wake screen user interface includes displaying at least one media playback control in the wake screen user interface

624 While the wake screen user interface is displayed, detect a fourth input by a contact on the touch-sensitive surface, including detecting movement of the contact along the touch-sensitive surface in a first direction and detecting lift-off of the contact after the movement; and
in response to detecting the fourth input:
moving at least one object displayed on the wake screen user interface in accordance with the movement of the contact; and,
reversing the movement of the at least one object upon lift-off of the contact

C

Figure 6C

600

C

626 While displaying the one or more notifications on the wake screen user interface, detect a fifth input by a contact on the touch-sensitive surface at a location that corresponds to a first notification of the one or more notifications; and,
in response to detecting the fifth input:
cease to display the wake screen user interface; and
display a first application user interface for a first application that corresponds to the first notification

628 While displaying the first application user interface for the first application that corresponds to the first notification, detect a sixth input for redisplaying the wake screen user interface;
in response to detecting the sixth input for redisplaying the wake screen user interface:
cease to display the first application user interface,
display the wake screen user interface,
display at least one second notification of the one or more notifications on the wake screen user interface, wherein the at least one second notification corresponds to a second application that is distinct from the first application, and
forgo display of the first notification on the wake screen user interface with the at least one second notification

630 After detecting the sixth input, while displaying the wake screen user interface, detect a seventh input for dismissing the wake screen user interface; and
in response to detecting the seventh input for dismissing the wake screen user interface:
cease to display the wake screen user interface, and
redisplay the first application user interface for the first application

D

Figure 6D

600

626

628

630

D

632 While the first application user interface for the first application is redisplayed, detect an eighth input for invoking a third application that is distinct from the first application and the second application; and
in response to detecting the eighth input for invoking the third application:
display a third application user interface of the third application;
after detecting the eighth input, while displaying the third application user interface, detect a ninth input for redisplaying the wake screen user interface;
in response to detecting the ninth input for redisplaying the wake screen user interface:
cease to display the third application user interface;
display the wake screen user interface; and
redisplay the at least one second notification of the one or more notifications on the wake screen user interface without redisplaying the first notification

634 After displaying the at least one second notification without displaying the first notification on the wake screen user interface, detect a first transition from the screen-on state to the screen-off state followed by a second transition from the screen-off state to the screen-on state; and
in response to detecting the first transition followed by the second transition:
redisplay the wake screen user interface without displaying any of the one or more notifications on the wake screen user interface

E

Figure 6E

600

E

636 While displaying the wake screen user interface with all of the one or more notifications, detect a third transitioning from the screen-on state to the screen-off state followed by a fourth transition from the screen-off state to the screen-on state; and
in response to detecting the third transition followed by the fourth transition:
redisplay the wake screen user interface with the one or more notifications on the wake screen user interface

638 While displaying the wake screen user interface with the one or more notifications, detect a tenth input for displaying an authentication user interface;
in response to detecting the tenth input for displaying the authentication user interface:
cease to display the wake screen user interface; and
display the authentication user interface;
while the authentication user interface is displayed, detect an authorization input;
in accordance with a determination that the authorization input is valid, display a second user interface;
while displaying the second user interface, detect an eleventh input for redisplaying the wake screen user interface; and,
in response to detecting the eleventh input:
cease to display the second application user interface; and
redisplay the wake screen user interface with the one or more notifications

640 In accordance with the determination that the third input meets the notification-clearance criteria, add, to a set of recent notifications, one or more cleared notifications that correspond to the at least one of the one or more not displayed on the wake screen user interface

F

Figure 6F

600

640

F

642 After adding the one or more cleared notifications to the set of recent notifications, while the wake screen user interface is displayed, detect a twelfth input; and
in response to detecting the twelfth input, in accordance with a determination that the twelfth input meets recent-notification-display criteria, display at least a portion of the set of recent notifications

Figure 6G

700

702 Display a first user interface, including displaying one or more missed notifications in a first scrollable arrangement on the first user interface

↓

704 While displaying the first user interface with the one or more missed notifications, detect a first swipe gesture, including detecting a first contact at a location on the touch-sensitive surface that corresponds to the first scrollable arrangement, and detecting first movement of the first contact across the touch-sensitive surface in a first direction

↓

706 In response to detecting the first swipe gesture, scroll the first scrollable arrangement in accordance with the first movement of the first contact

↓

708 After scrolling the first scrollable arrangement in accordance with the first movement of the first contact, detect a second swipe gesture, including detecting a second contact at a location on the touch-sensitive surface that corresponds to the first scrollable arrangement, and detecting second movement of the second contact across the touch-sensitive surface in the first direction

↓

710 In response to detecting the second swipe gesture:

in accordance with a determination that the second movement of the second contact meets notification-history-display criteria, wherein the notification-history-display criteria require (1) that the second movement of the second contact is detected after an end of the first scrollable arrangement has been reached in accordance with the first movement of the first contact and (2) that the second movement exceeds a first threshold amount of movement in the first direction, display a plurality of previously received notifications that are distinct from the one or more missed notifications in a second scrollable arrangement on the first user interface; and,

in accordance with the determination that the second movement of the first contact does not meet the notification-history-display criteria, forgo displaying the plurality of previously received notifications

A

Figure 7A

700

A

712 The first user interface is a wake screen user interface, and the first user interface is displayed immediately upon waking the device from the display-off state to the display-on state

714 While displaying the one or more missed notifications in the first scrollable arrangement on the first user interface, detect a missed notification dismissal input for dismissing a respective notification of the one or more missed notifications in the first scrollable arrangement;
after detecting the missed notification dismissal input for dismissing the respective notification:
cease to display the respective notification of the one or more notifications on the first user interface, and
add the respective notification to the plurality of previously received notifications

716 While the first user interface is displayed, detect a third swipe gesture, including detecting a third contact at a location on the touch-sensitive surface that corresponds the first scrollable arrangement and detecting third movement of the third contact across the touch-sensitive surface in a second direction that is distinct from the first direction;
in response to detecting the third swipe gesture, translate the first scrollable arrangement in accordance with the third movement of the third contact;
detect lift-off of the third contact from the touch-sensitive surface after detecting the third movement; and,
in response to detecting the liftoff of the third contact, reverse the translation of the first scrollable arrangement that was made in accordance with the third movement of the third contact

B

Figure 7B

700

B

718 While displaying the plurality of previously received notifications in the second scrollable arrangement on the first user interface, detect a fourth swipe gesture, including detecting a fourth contact at a location on the touch-sensitive surface that corresponds to the second scrollable arrangement and detecting fourth movement of the fourth contact across the touch-sensitive surface in a second direction opposite the first direction; and,
in response to detecting the fourth swipe gesture:
in accordance with a determination that the fourth movement of the fourth contact meets notification-history-dismissal criteria, wherein the notification-history-dismissal criteria require (1) that the fourth movement of the fourth contact is detected after an end of the second scrollable arrangement has been reached and (2) that the fourth movement exceeds a second threshold amount of movement in the second direction opposite the first direction, cease to display the plurality of previously received notifications on the first user interface; and,
in accordance with the determination that the fourth movement of the fourth contact does not meet the notification-history-dismissal criteria, scroll the plurality of previously received notifications in the second scrollable arrangement in accordance with the fourth movement of the fourth contact

720 While displaying the first user interface, detect a first user interface dismissal input for input for dismissing the first user interface; and,
in response to detecting the first user interface dismissal input, cease to display the first user interface

722 The device includes one or more tactile output generators, and the method includes:
while the first user interface is displayed, in accordance with the determination that the second movement of the second contact meets the notification-history-display criteria, generating, with the one or more tactile output generators, a tactile output to indicate that the criteria for displaying the plurality of previously received notifications have been met

C

Figure 7C

700

C

724 The first contact moves with a first rate of movement during the first swipe gesture;
scrolling the first scrollable arrangement occurs at a first scroll rate that corresponds to the first rate of movement by the first contact;
the second contact moves with a second rate of movement during the second swipe gesture; and
displaying the plurality of previously received notifications in the second scrollable arrangement includes scrolling a first previously received notification of the plurality of previously received notifications in the second scrollable arrangement at a second scroll rate that is greater than the second rate of movement by the second contact

726 Detect a fifth swipe gesture, including detecting a fifth contact at a first location on the touch-sensitive surface and detecting fifth movement of the fifth contact across the touch-sensitive surface in a third direction that is perpendicular to the first direction;
in response to detecting the fifth swipe gesture:
in accordance with a determination that the first location on the touch-sensitive surface corresponds to a first notification among the one or more missed notifications or the plurality of previously received notifications, dismiss the first notification; and
in accordance with a determination that the first location on the touch-sensitive surface corresponds to a location outside of the first scrollable arrangement and the second scrollable arrangement:
replace display of the first user interface with display of a second user interface

D

Figure 7D

700

D

728 Detect that criteria for dismissing all of the one or more missed notifications in the first scrollable arrangement are met; and
in response to detecting that the criteria for dismissing all of the one or more missed notifications are met:
add, to the plurality of previously received notifications, all of the one or more missed notifications

730 While displaying the first user interface without any missed notifications, detect a sixth swipe gesture, including a sixth contact at a location on the touch-sensitive surface that corresponds to the location at which the first scrollable arrangement was previously displayed, and detecting sixth movement of the sixth contact across the touch-sensitive surface in the first direction;
in response to detecting the sixth swipe gesture:
in accordance with a determination that the sixth movement of the sixth contact exceeds the first threshold amount of movement in the first direction, display the plurality of previously received notifications; and
in accordance with the determination that the sixth movement of the sixth contact does not exceed the first threshold amount of movement in the first direction, forgo displaying the plurality of previously received notifications

732 While the first user interface is displayed without any missed notifications, detect a seventh swipe gesture, including detecting a seventh contact at a location on the touch-sensitive surface that corresponds to the location at which the first scrollable arrangement was previously displayed, detecting seventh movement of the seventh contact across the touch-sensitive surface in a second direction opposite the first direction; in response to detecting the seventh swipe gesture, translating at least one object displayed on the first user interface in the second direction in accordance with the seventh movement of the seventh contact;
after translating the at least one object, detect lift-off of the seventh contact; and
in response to detecting liftoff of the seventh contact from the touch-sensitive surface, reverse the translation of the at least one object that have been made in accordance with the seventh movement of the seventh contact

Figure 7E

800

802 Display a first user interface on the display

↓

804 Display a first user interface object overlaid on a first portion of the first user interface

↓

806 While displaying the first user interface object overlaid on the first portion of the first user interface, detect a first input for displaying a cover sheet user interface, where the cover sheet user interface includes a first content object and a second content object displayed on a background object

↓

808 In response to detecting the first input for displaying the cover sheet user interface, move the cover sheet user interface across the display in a first direction, including:

moving the background object of the cover sheet user interface across the display;

in accordance with a determination that the first user interface object has not reached a predefined threshold position relative to the cover sheet user interface, moving the first content object and the second content object with the background object while maintaining a current position of the first user interface object on the display; and,

in accordance with a determination that the first user interface object has reached the predefined threshold position relative to the cover sheet user interface, moving the first user interface object with the background object

810 Moving the cover sheet user interface across the display in the first direction includes:

in accordance with a determination that the second content object has reached a first predefined location on the display:

ceasing to move the second content object and the first user interface object; and

continuing to move the first content object in the first direction

A

Figure 8A

800

810

A

812 Cease to continue to move the first content object in the first direction in accordance with a determination that the first content object has reached a second predefined location on the display

814 Transition the device from a screen-on state to a screen-off state in accordance with a determination that display shutoff criteria are met; and, while the display is in the screen-off state, display the first user interface object on a dark screen corresponding to the screen-off state

816 While the display is in the screen-off state and the first user interface object is displayed on the display:

receive one or more notifications; and,

in response to receiving the one or more notifications, display the first user interface object and a third content object on the first user interface

818 Transition the device from a screen-off state to a screen-on state in accordance with a determination that display-waking criteria are met; and in response to transitioning the device from the screen-off state to the screen-on state, display the first user interface object on a dark screen that corresponds to the display-off state

820 While the cover sheet interface is displayed, detect a third input for dismissing the cover sheet user interface, wherein the third input includes a swipe gesture by a contact on the touch-sensitive surface; and in response to detecting the third input for dismissing the cover sheet user interface:

cease to display the cover sheet user interface;

maintain display of the first user interface object; and

display a home screen user interface, wherein the first user interface object is overlaid on the home screen user interface

B

Figure 8B

800

B

820

822 While displaying the first user interface object overlaid on the home screen user interface, detect an input for minimizing the first user interface object;
in response to detecting the input for minimizing the first user interface object:
transition the first user interface object into a second user interface object, wherein the first user interface object has a first size and the second user interface object has a second size that is smaller than the first size

824 While the second user interface object is displayed, determine that the display shutoff criteria are met; and
in response to determining that the display shutoff criteria are met:
transition the device from the screen-on state to a screen-off state;
transition the second user interface object into the first user interface object; and
display the first user interface object overlaid a dark screen corresponding to the screen-off state

826 While the second user interface object is displayed, detect an input for activating the second user interface object; and
in response to detecting the input for activating the second user interface object, display an application user interface of an application that corresponds to the second user interface object

828 While the first user interface object is displayed, detect an input that activates the first user interface object; and
in response to detecting the input that activates the first user interface object, display the application user interface of the application that corresponds to the information displayed in the first user interface object

Figure 8C

900

902 While the device is in a screen-off state, detect a first input for waking the device from the screen-off state to a screen-on state; and

904 In response to detecting the first input for waking the device from the screen-off state to the screen-on state:

transition the device from the screen-off state to the screen-on state, and

display a wake screen user interface on the display;

906 While displaying the wake screen user interface, detect a first swipe gesture on the touch-sensitive surface, including detecting a first contact on the touch-sensitive surface and detecting movement of the first contact across the touch-sensitive surface;

908 In response to detecting the first swipe gesture:

cease to display the wake screen user interface; and

display a first user interface, wherein:

in accordance with a determination that the first swipe gesture is in a first direction, the displayed first user interface is a mini-application-object user interface, wherein the mini-application-object user interface includes one or more mini-application objects that each provide a subset of functions of a corresponding application without launching the corresponding application; and,

in accordance with a determination that the first swipe gesture is in a second direction that is opposite the first direction, the displayed first user interface is a control panel user interface, wherein the control panel user interface includes one or more device controls for controlling one or more device functions of the device

A

Figure 9A

900

A

910 While the wake screen user interface is displayed, display one or more notifications on the wake screen user interface;
detect a second input for transitioning the device from an unauthenticated state to an authenticated state; and
in response to detecting the second input, display, on the wake screen user interface, restricted notification information corresponding to at least one of the one or more notifications

912 While displaying the first user interface in response to the first swipe gesture, detect a second swipe gesture in a third direction that is perpendicular to the first direction and the second direction:
in accordance with a determination that the device is in an unauthenticated state, display an authentication user interface; and,
in accordance with a determination that the device is in an authenticated state, display a second user interface, wherein the second user interface is a last displayed user interface that was displayed prior to the display of the wake screen user interface

914 In accordance with a determination that the second user interface is a home screen user interface, display, in the home screen user interface, an object that displays content from a first active application; and,
in accordance with a determination that a state of the first active application has changed, update the content displayed in the object in accordance with the changed state of the first active application

916 While displaying the second user interface in response to the second swipe gesture, detect a third swipe gesture in a fourth direction that is opposite the third direction; and
in response to detecting the third swipe gesture in the fourth direction, cease to display the second user interface and redisplay the wake screen user interface

B

Figure 9B

900

B

918 The wake screen user interface is displayed with an affordance that displays content from a second active application, the method including:
while displaying the wake screen user interface with the affordance, in accordance with a determination that a state of the second active application has changed, updating the content displayed in the affordance in accordance with the changed state of the second active application

920 The wake screen user interface includes a first control of the one or more device controls of the control panel user interface

922 The first control requires a first type of input to activate a first function while displayed on the wake screen user interface and the first control requires a second type of input to activate the first function while displayed on the control panel user interface

924 The first control is also displayed on the home screen user interface, and a press input directed to the first control while displayed on the home screen user interface causes display of a plurality of selectable options, and a press input directed to the first control while displayed on the wake screen user interface does not cause display of the plurality of selectable options

926 While displaying the wake screen user interface, display a first object at a first position on the display;
in accordance with the determination that the first swipe gesture is in the first direction, display the first object on the first user interface at a second position that is shifted in the first direction relative to the first position on the display; and,
in accordance with the determination that the first swipe gesture is in the second direction, display the at least one object at a third position that is shifted in the second direction relative to the first position on the display

Figure 9C

DEVICES, METHODS, AND GRAPHICAL USER INTERFACES FOR ACCESSING NOTIFICATIONS

RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 16/354,012, filed Mar. 14, 2019, which is a continuation of U.S. application Ser. No. 15/715,005, filed Sep. 25, 2017, now U.S. Pat. No. 10,466,889, which claims priority to U.S. Provisional Application No. 62/507,181, filed May 16, 2017, which are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

This relates generally to electronic devices with touch-sensitive surfaces, including but not limited to electronic devices with touch-sensitive surfaces that include user interfaces for displaying notifications.

BACKGROUND

The use of portable electronic devices has increased significantly in recent years, with many applications typically residing in the memory of such devices. Exemplary applications include messaging applications, calendar applications and social media applications. Electronic devices often receive communications for these applications, which contain information of importance to users. These electronic devices then often provide notifications that correspond to the received communications.

Exemplary communications include instant messages, calendar invitations, social media updates, microblog posts and news stories. Exemplary notifications associated with these communications may include digital images, video, text, icons, control elements (such as buttons) and/or other graphics to notify users of the receipt of these communications. Exemplary applications receiving communications and generating notifications include instant messaging applications (e.g., iMessage from Apple Inc. of Cupertino, Calif.), calendar applications (e.g., iCal or Calendar from Apple Inc. of Cupertino, Calif.), social networking applications, microblogging applications, and news applications.

But user interfaces for accessing notifications, and methods of navigating to and from such interfaces, are cumbersome and inefficient. For example, the notifications may be displayed in a confusing manner, and navigation to and from interfaces that contain notifications may also be confusing. These methods take longer than necessary, thereby wasting energy. This latter consideration is particularly important in battery-operated devices.

SUMMARY

Accordingly, there is a need for electronic devices with faster, more efficient methods and interfaces for accessing notifications. Such methods and interfaces optionally complement or replace conventional methods for accessing notifications. Such methods and interfaces reduce the number, extent, and/or nature of the inputs from a user and produce a more efficient human-machine interface. For battery-operated devices, such methods and interfaces conserve power and increase the time between battery charges.

The above deficiencies and other problems associated with user interfaces for electronic devices with touch-sensitive surfaces are reduced or eliminated by the disclosed devices. In some embodiments, the device is a desktop

computer. In some embodiments, the device is portable (e.g., a notebook computer, tablet computer, or handheld device). In some embodiments, the device is a personal electronic device (e.g., a wearable electronic device, such as a watch). In some embodiments, the device has a touchpad. In some embodiments, the device has a touch-sensitive display (also known as a "touch screen" or "touch-screen display"). In some embodiments, the device has a graphical user interface (GUI), one or more processors, memory and one or more modules, programs or sets of instructions stored in the memory for performing multiple functions. In some embodiments, the user interacts with the GUI primarily through stylus and/or finger contacts and gestures on the touch-sensitive surface. In some embodiments, the functions optionally include image editing, drawing, presenting, word processing, spreadsheet making, game playing, telephoning, video conferencing, e-mailing, instant messaging, workout support, digital photographing, digital videoing, web browsing, digital music playing, note taking, and/or digital video playing. Executable instructions for performing these functions are, optionally, included in a non-transitory computer readable storage medium or other computer program product configured for execution by one or more processors.

In accordance with some embodiments, a method is performed at a device having a display and a touch-sensitive surface. The method includes: while the device is in a screen-off state, receiving one or more notifications; after receiving the one or more notifications, detecting a first input from a user for waking the device from the screen-off state to a screen-on state; in response to detecting the first input for waking the device from the screen-off state to the screen-on state: transitioning the device from the screen-off state to the screen-on state; displaying a wake screen user interface on the display; and displaying the one or more notifications on the wake screen user interface; while displaying the wake screen user interface and while at least one of the one or more notifications remains displayed on the wake screen user interface, detecting a second input for dismissing the wake screen user interface; in response to detecting the second input for dismissing the wake screen user interface, ceasing to display the wake screen user interface and the at least one of the one or more notifications; after ceasing to display the wake screen user interface and the at least one of the one or more notifications in response to the second input, detecting a third input for redisplaying the wake screen user interface; in response to detecting the third input for redisplaying the wake screen user interface: in accordance with a determination that the third input meets notification-clearance criteria, wherein the notification-clearance criteria require that the third input is detected at a time that is (1) after a respective notification of the one or more notifications has been cleared through direct user interaction with the respective notification or an application that corresponds to the respective notification and (2) after the device has transitioned from the screen-on state to the screen-off state at least once since the detection of the second input, redisplaying the wake screen user interface without displaying the at least one of the one or more notifications on the redisplayed wake screen user interface; and in accordance with a determination that the third input does not meet the notification-clearance criteria: redisplaying the wake screen user interface, and redisplaying the at least one of the one or more notifications on the redisplayed wake screen user interface.

In accordance with some embodiments, a method is performed at a device having a display and a touch-sensitive surface. The method includes: displaying a first user inter-

face, including displaying one or more missed notifications in a first scrollable arrangement on the first user interface; while displaying the first user interface with the one or more missed notifications, detecting a first swipe gesture, including detecting a first contact at a location on the touch-sensitive surface that corresponds to the first scrollable arrangement, and detecting first movement of the first contact across the touch-sensitive surface in a first direction; in response to detecting the first swipe gesture, scrolling the first scrollable arrangement in accordance with the first movement of the first contact; after scrolling the first scrollable arrangement in accordance with the first movement of the first contact, detecting a second swipe gesture, including detecting a second contact at a location on the touch-sensitive surface that corresponds to the first scrollable arrangement, and detecting second movement of the second contact across the touch-sensitive surface in the first direction; in response to detecting the second swipe gesture: in accordance with a determination that the second movement of the second contact meets notification-history-display criteria, wherein the notification-history-display criteria require (1) that the second movement of the second contact is detected after an end of the first scrollable arrangement has been reached in accordance with the first movement of the first contact and (2) that the second movement exceeds a first threshold amount of movement in the first direction, displaying a plurality of previously received notifications that are distinct from the one or more missed notifications in a second scrollable arrangement on the first user interface; and, in accordance with the determination that the second movement of the first contact does not meet the notification-history-display criteria, forgoing displaying the plurality of previously received notifications.

In accordance with some embodiments, a method is performed at a device having a display and a touch-sensitive surface. The method includes: displaying a first user interface on the display; displaying a first user interface object overlaid on a first portion of the first user interface; while displaying the first user interface object overlaid on the first portion of the first user interface, detecting a first input for displaying a cover sheet user interface, where the cover sheet user interface includes a first content object and a second content object displayed on a background object; in response to detecting the first input for displaying the cover sheet user interface, moving the cover sheet user interface across the display in a first direction, including: moving the background object of the cover sheet user interface across the display; in accordance with a determination that the first user interface object has not reached a predefined threshold position relative to the cover sheet user interface, moving the first content object and the second content object with the background object while maintaining a current position of the first user interface object on the display; and, in accordance with a determination that the first user interface object has reached the predefined threshold position relative to the cover sheet user interface, moving the first user interface object with the background object.

In accordance with some embodiments, a method is performed at a device having a display and a touch-sensitive surface. The method includes: while the device is in a screen-off state, detecting a first input for waking the device from the screen-off state to a screen-on state; and in response to detecting the first input for waking the device from the screen-off state to the screen-on state: transitioning the device from the screen-off state to the screen-on state, and displaying a wake screen user interface on the display; while displaying the wake screen user interface, detecting a first

swipe gesture on the touch-sensitive surface, including detecting a first contact on the touch-sensitive surface and detecting movement of the first contact across the touch-sensitive surface; in response to detecting the first swipe gesture: ceasing to display the wake screen user interface; and displaying a first user interface, wherein: in accordance with a determination that the first swipe gesture is in a first direction, the displayed first user interface is a mini-application-object user interface, wherein the mini-application-object user interface includes one or more mini-application objects that each provide a subset of functions of a corresponding application without launching the corresponding application; and, in accordance with a determination that the first swipe gesture is in a second direction that is opposite the first direction, the displayed first user interface is a control panel user interface, wherein the control panel user interface includes one or more device controls for controlling one or more device functions of the device.

In accordance with some embodiments, an electronic device includes a display, a touch-sensitive surface, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, optionally one or more tactile output generators, one or more processors, and memory storing one or more programs; the one or more programs are configured to be executed by the one or more processors and the one or more programs include instructions for performing or causing performance of the operations of any of the methods described herein. In accordance with some embodiments, a computer readable storage medium has stored therein instructions, which, when executed by an electronic device with a display, a touch-sensitive surface, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators, cause the device to perform or cause performance of the operations of any of the methods described herein. In accordance with some embodiments, a graphical user interface on an electronic device with a display, a touch-sensitive surface, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, optionally one or more tactile output generators, a memory, and one or more processors to execute one or more programs stored in the memory includes one or more of the elements displayed in any of the methods described herein, which are updated in response to inputs, as described in any of the methods described herein. In accordance with some embodiments, an electronic device includes: a display, a touch-sensitive surface, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators; and means for performing or causing performance of the operations of any of the methods described herein. In accordance with some embodiments, an information processing apparatus, for use in an electronic device with a display, a touch-sensitive surface, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators, includes means for performing or causing performance of the operations of any of the methods described herein.

Thus, electronic devices with displays, touch-sensitive surfaces, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, optionally one or more tactile output generators, optionally one or more device orientation sensors, are provided with improved interfaces for accessing notifications and improved navigation to and from such interfaces, thereby increasing the effectiveness, efficiency, and user satisfaction with such

devices. Such methods and interfaces may complement or replace conventional methods for providing accessing notifications.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the various described embodiments, reference should be made to the Description of Embodiments below, in conjunction with the following drawings in which like reference numerals refer to corresponding parts throughout the figures.

FIG. **1**A is a block diagram illustrating a portable multifunction device with a touch-sensitive display, in accordance with some embodiments.

FIG. **1**B is a block diagram illustrating example components for event handling, in accordance with some embodiments.

FIG. **1**C is a block diagram illustrating a tactile output module, in accordance with some embodiments.

FIG. **2** illustrates a portable multifunction device having a touch screen, in accordance with some embodiments.

FIG. **3** is a block diagram of an example multifunction device with a display and a touch-sensitive surface, in accordance with some embodiments.

FIG. **4**A illustrates an example user interface for a menu of applications on a portable multifunction device, in accordance with some embodiments.

FIG. **4**B illustrates an example user interface for a multifunction device with a touch-sensitive surface that is separate from the display, in accordance with some embodiments.

FIGS. **4**C-**4**E illustrate examples of dynamic intensity thresholds, in accordance with some embodiments.

FIGS. **5**A**1**-**5**A**4**, **5**B-**5**EB, **5**EC**1**-**5**EC**4**, **5**ED-**5**HR illustrate example user interfaces for providing access to notifications on a cover sheet user interface in accordance with some embodiments.

FIGS. **6**A-**6**G are flow diagrams of a process for clearing sets of notifications, in accordance with some embodiments.

FIGS. **7**A-**7**E are flow diagrams of a process for displaying notification history, in accordance with some embodiments.

FIGS. **8**A-**8**C are flow diagrams of a process for displaying updating information from an application in a floating banner, in accordance with some embodiments.

FIGS. **9**A-**9**C are flow diagrams of a process for navigation using a cover sheet, in accordance with some embodiments.

DESCRIPTION OF EMBODIMENTS

A number of different approaches for navigating to, displaying, and/or interacting with notification content and user interfaces that display notifications are described herein. Using one or more of these approaches (optionally in conjunction with each other) reduces the number, extent, and/or nature of the inputs from a user and provides a more efficient human-machine interface. For battery-operated devices, these improvements conserve power and increase the time between battery charges. These approaches describe improved methods for:

- clearing individual notifications and clearing sets of notifications;
- displaying notification history;
- displaying updating information from an application in a floating banner; and
- navigating from a user interface that displays notifications to adjacent user interfaces that display device controls and/or application controls.

The methods, devices, and GUIs described herein display notifications on a cover sheet to present recent information received and/or generated by applications installed on a device, which makes the user-device interface more efficient in multiple ways. For example, they provide more efficient ways to retain sets of notifications, clear sets of notifications, display missed notifications, display previously cleared notifications in a notification history, access information from an active mode of an application using a banner that is displayed in user interfaces other than the application user interface, and access additional user interfaces from a cover sheet user interface.

Below, FIGS. **1**A-**1**B, **2**, and **3** provide a description of example devices. FIGS. **4**A-**4**B and **5**A-**5**HR illustrate example user interfaces for providing access to notifications on a cover sheet user interface. FIGS. **6**A-**6**G illustrate a flow diagram of a method of clearing notifications in accordance with some embodiments. FIGS. **7**A-**7**E illustrate a flow diagram of a method of displaying notification history in accordance with some embodiments. FIGS. **8**A-**8**C illustrate a flow diagram of a method of displaying updating information from an application in a floating banner in accordance with some embodiments. FIGS. **9**A-**9**C illustrate a flow diagram of a method of navigation using a cover sheet in accordance with some embodiments. The user interfaces in FIGS. **5**A-**5**HR are used to illustrate the processes in FIGS. **6**A-**6**G, **7**A-**7**E, **8**A-**8**C, and **9**A-**9**C.

Example Devices

Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the various described embodiments. However, it will be apparent to one of ordinary skill in the art that the various described embodiments may be practiced without these specific details. In other instances, well-known methods, procedures, components, circuits, and networks have not been described in detail so as not to unnecessarily obscure aspects of the embodiments.

It will also be understood that, although the terms first, second, etc. are, in some instances, used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first contact could be termed a second contact, and, similarly, a second contact could be termed a first contact, without departing from the scope of the various described embodiments. The first contact and the second contact are both contacts, but they are not the same contact, unless the context clearly indicates otherwise.

The terminology used in the description of the various described embodiments herein is for the purpose of describing particular embodiments only and is not intended to be limiting. As used in the description of the various described embodiments and the appended claims, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that the term "and/or" as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. It will be further understood that the terms "includes," "including," "comprises," and/or "comprising," when used in this speci-

fication, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

As used herein, the term "if" is, optionally, construed to mean "when" or "upon" or "in response to determining" or "in response to detecting," depending on the context. Similarly, the phrase "if it is determined" or "if [a stated condition or event] is detected" is, optionally, construed to mean "upon determining" or "in response to determining" or "upon detecting [the stated condition or event]" or "in response to detecting [the stated condition or event]," depending on the context.

Embodiments of electronic devices, user interfaces for such devices, and associated processes for using such devices are described. In some embodiments, the device is a portable communications device, such as a mobile telephone, that also contains other functions, such as PDA and/or music player functions. Example embodiments of portable multifunction devices include, without limitation, the iPhone®, iPod Touch®, and iPad® devices from Apple Inc. of Cupertino, Calif. Other portable electronic devices, such as laptops or tablet computers with touch-sensitive surfaces (e.g., touch-screen displays and/or touchpads), are, optionally, used. It should also be understood that, in some embodiments, the device is not a portable communications device, but is a desktop computer with a touch-sensitive surface (e.g., a touch-screen display and/or a touchpad).

In the discussion that follows, an electronic device that includes a display and a touch-sensitive surface is described. It should be understood, however, that the electronic device optionally includes one or more other physical user-interface devices, such as a physical keyboard, a mouse and/or a joystick.

The device typically supports a variety of applications, such as one or more of the following: a note taking application, a drawing application, a presentation application, a word processing application, a website creation application, a disk authoring application, a spreadsheet application, a gaming application, a telephone application, a video conferencing application, an e-mail application, an instant messaging application, a workout support application, a photo management application, a digital camera application, a digital video camera application, a web browsing application, a digital music player application, and/or a digital video player application.

The various applications that are executed on the device optionally use at least one common physical user-interface device, such as the touch-sensitive surface. One or more functions of the touch-sensitive surface as well as corresponding information displayed on the device are, optionally, adjusted and/or varied from one application to the next and/or within a respective application. In this way, a common physical architecture (such as the touch-sensitive surface) of the device optionally supports the variety of applications with user interfaces that are intuitive and transparent to the user.

Attention is now directed toward embodiments of portable devices with touch-sensitive displays. FIG. **1**A is a block diagram illustrating portable multifunction device **100** with touch-sensitive display system **112** in accordance with some embodiments. Touch-sensitive display system **112** is sometimes called a "touch screen" for convenience, and is sometimes simply called a touch-sensitive display. Device **100** includes memory **102** (which optionally includes one or more computer readable storage mediums), memory controller **122**, one or more processing units (CPUs) **120**, peripherals interface **118**, RF circuitry **108**, audio circuitry **110**, speaker **111**, microphone **113**, input/output (I/O) subsystem **106**, other input or control devices **116**, and external port **124**. Device **100** optionally includes one or more optical sensors **164**. Device **100** optionally includes one or more intensity sensors **165** for detecting intensities of contacts on device **100** (e.g., a touch-sensitive surface such as touch-sensitive display system **112** of device **100**). Device **100** optionally includes one or more tactile output generators **167** for generating tactile outputs on device **100** (e.g., generating tactile outputs on a touch-sensitive surface such as touch-sensitive display system **112** of device **100** or touchpad **355** of device **300**). These components optionally communicate over one or more communication buses or signal lines **103**.

As used in the specification and claims, the term "tactile output" refers to physical displacement of a device relative to a previous position of the device, physical displacement of a component (e.g., a touch-sensitive surface) of a device relative to another component (e.g., housing) of the device, or displacement of the component relative to a center of mass of the device that will be detected by a user with the user's sense of touch. For example, in situations where the device or the component of the device is in contact with a surface of a user that is sensitive to touch (e.g., a finger, palm, or other part of a user's hand), the tactile output generated by the physical displacement will be interpreted by the user as a tactile sensation corresponding to a perceived change in physical characteristics of the device or the component of the device. For example, movement of a touch-sensitive surface (e.g., a touch-sensitive display or trackpad) is, optionally, interpreted by the user as a "down click" or "up click" of a physical actuator button. In some cases, a user will feel a tactile sensation such as an "down click" or "up click" even when there is no movement of a physical actuator button associated with the touch-sensitive surface that is physically pressed (e.g., displaced) by the user's movements. As another example, movement of the touch-sensitive surface is, optionally, interpreted or sensed by the user as "roughness" of the touch-sensitive surface, even when there is no change in smoothness of the touch-sensitive surface. While such interpretations of touch by a user will be subject to the individualized sensory perceptions of the user, there are many sensory perceptions of touch that are common to a large majority of users. Thus, when a tactile output is described as corresponding to a particular sensory perception of a user (e.g., an "up click," a "down click," "roughness"), unless otherwise stated, the generated tactile output corresponds to physical displacement of the device or a component thereof that will generate the described sensory perception for a typical (or average) user. Using tactile outputs to provide haptic feedback to a user enhances the operability of the device and makes the user-device interface more efficient (e.g., by helping the user to provide proper inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

In some embodiments, a tactile output pattern specifies characteristics of a tactile output, such as the amplitude of the tactile output, the shape of a movement waveform of the tactile output, the frequency of the tactile output, and/or the duration of the tactile output.

When tactile outputs with different tactile output patterns are generated by a device (e.g., via one or more tactile output generators that move a moveable mass to generate tactile outputs), the tactile outputs may invoke different haptic

sensations in a user holding or touching the device. While the sensation of the user is based on the user's perception of the tactile output, most users will be able to identify changes in waveform, frequency, and amplitude of tactile outputs generated by the device. Thus, the waveform, frequency and amplitude can be adjusted to indicate to the user that different operations have been performed. As such, tactile outputs with tactile output patterns that are designed, selected, and/or engineered to simulate characteristics (e.g., size, material, weight, stiffness, smoothness, etc.); behaviors (e.g., oscillation, displacement, acceleration, rotation, expansion, etc.); and/or interactions (e.g., collision, adhesion, repulsion, attraction, friction, etc.) of objects in a given environment (e.g., a user interface that includes graphical features and objects, a simulated physical environment with virtual boundaries and virtual objects, a real physical environment with physical boundaries and physical objects, and/or a combination of any of the above) will, in some circumstances, provide helpful feedback to users that reduces input errors and increases the efficiency of the user's operation of the device. Additionally, tactile outputs are, optionally, generated to correspond to feedback that is unrelated to a simulated physical characteristic, such as an input threshold or a selection of an object. Such tactile outputs will, in some circumstances, provide helpful feedback to users that reduces input errors and increases the efficiency of the user's operation of the device.

In some embodiments, a tactile output with a suitable tactile output pattern serves as a cue for the occurrence of an event of interest in a user interface or behind the scenes in a device. Examples of the events of interest include activation of an affordance (e.g., a real or virtual button, or toggle switch) provided on the device or in a user interface, success or failure of a requested operation, reaching or crossing a boundary in a user interface, entry into a new state, switching of input focus between objects, activation of a new mode, reaching or crossing an input threshold, detection or recognition of a type of input or gesture, etc. In some embodiments, tactile outputs are provided to serve as a warning or an alert for an impending event or outcome that would occur unless a redirection or interruption input is timely detected. Tactile outputs are also used in other contexts to enrich the user experience, improve the accessibility of the device to users with visual or motor difficulties or other accessibility needs, and/or improve efficiency and functionality of the user interface and/or the device. Tactile outputs are optionally accompanied with audio outputs and/or visible user interface changes, which further enhance a user's experience when the user interacts with a user interface and/or the device, and facilitate better conveyance of information regarding the state of the user interface and/or the device, and which reduce input errors and increase the efficiency of the user's operation of the device.

It should be appreciated that device **100** is only one example of a portable multifunction device, and that device **100** optionally has more or fewer components than shown, optionally combines two or more components, or optionally has a different configuration or arrangement of the components. The various components shown in FIG. **1**A are implemented in hardware, software, firmware, or a combination thereof, including one or more signal processing and/or application specific integrated circuits.

Memory **102** optionally includes high-speed random access memory and optionally also includes non-volatile memory, such as one or more magnetic disk storage devices, flash memory devices, or other non-volatile solid-state memory devices. Access to memory **102** by other components of device **100**, such as CPU(s) **120** and the peripherals interface **118**, is, optionally, controlled by memory controller **122**.

Peripherals interface **118** can be used to couple input and output peripherals of the device to CPU(s) **120** and memory **102**. The one or more processors **120** run or execute various software programs and/or sets of instructions stored in memory **102** to perform various functions for device **100** and to process data.

In some embodiments, peripherals interface **118**, CPU(s) **120**, and memory controller **122** are, optionally, implemented on a single chip, such as chip **104**. In some other embodiments, they are, optionally, implemented on separate chips.

RF (radio frequency) circuitry **108** receives and sends RF signals, also called electromagnetic signals. RF circuitry **108** converts electrical signals to/from electromagnetic signals and communicates with communications networks and other communications devices via the electromagnetic signals. RF circuitry **108** optionally includes well-known circuitry for performing these functions, including but not limited to an antenna system, an RF transceiver, one or more amplifiers, a tuner, one or more oscillators, a digital signal processor, a CODEC chipset, a subscriber identity module (SIM) card, memory, and so forth. RF circuitry **108** optionally communicates with networks, such as the Internet, also referred to as the World Wide Web (WWW), an intranet and/or a wireless network, such as a cellular telephone network, a wireless local area network (LAN) and/or a metropolitan area network (MAN), and other devices by wireless communication. The wireless communication optionally uses any of a plurality of communications standards, protocols and technologies, including but not limited to Global System for Mobile Communications (GSM), Enhanced Data GSM Environment (EDGE), high-speed downlink packet access (HSDPA), high-speed uplink packet access (HSDPA), Evolution, Data-Only (EV-DO), HSPA, HSPA+, Dual-Cell HSPA (DC-HSPA), long term evolution (LTE), near field communication (NFC), wideband code division multiple access (W-CDMA), code division multiple access (CDMA), time division multiple access (TDMA), Bluetooth, Wireless Fidelity (Wi-Fi) (e.g., IEEE 802.11a, IEEE 802.11ac, IEEE 802.11ax, IEEE 802.11b, IEEE 802.11g and/or IEEE 802.11n), voice over Internet Protocol (VoIP), Wi-MAX, a protocol for e-mail (e.g., Internet message access protocol (IMAP) and/or post office protocol (POP)), instant messaging (e.g., extensible messaging and presence protocol (XMPP), Session Initiation Protocol for Instant Messaging and Presence Leveraging Extensions (SIMPLE), Instant Messaging and Presence Service (IMPS)), and/or Short Message Service (SMS), or any other suitable communication protocol, including communication protocols not yet developed as of the filing date of this document.

Audio circuitry **110**, speaker **111**, and microphone **113** provide an audio interface between a user and device **100**. Audio circuitry **110** receives audio data from peripherals interface **118**, converts the audio data to an electrical signal, and transmits the electrical signal to speaker **111**. Speaker **111** converts the electrical signal to human-audible sound waves. Audio circuitry **110** also receives electrical signals converted by microphone **113** from sound waves. Audio circuitry **110** converts the electrical signal to audio data and transmits the audio data to peripherals interface **118** for processing. Audio data is, optionally, retrieved from and/or transmitted to memory **102** and/or RF circuitry **108** by peripherals interface **118**. In some embodiments, audio circuitry **110** also includes a headset jack (e.g., **212**, FIG. **2**).

The headset jack provides an interface between audio circuitry **110** and removable audio input/output peripherals, such as output-only headphones or a headset with both output (e.g., a headphone for one or both ears) and input (e.g., a microphone).

I/O subsystem **106** couples input/output peripherals on device **100**, such as touch-sensitive display system **112** and other input or control devices **116**, with peripherals interface **118**. I/O subsystem **106** optionally includes display controller **156**, optical sensor controller **158**, intensity sensor controller **159**, haptic feedback controller **161**, and one or more input controllers **160** for other input or control devices. The one or more input controllers **160** receive/send electrical signals from/to other input or control devices **116**. The other input or control devices **116** optionally include physical buttons (e.g., push buttons, rocker buttons, etc.), dials, slider switches, joysticks, click wheels, and so forth. In some alternate embodiments, input controller(s) **160** are, optionally, coupled with any (or none) of the following: a keyboard, infrared port, USB port, stylus, and/or a pointer device such as a mouse. The one or more buttons (e.g., **208**, FIG. **2**) optionally include an up/down button for volume control of speaker **111** and/or microphone **113**. The one or more buttons optionally include a push button (e.g., **206**, FIG. **2**).

Touch-sensitive display system **112** provides an input interface and an output interface between the device and a user. Display controller **156** receives and/or sends electrical signals from/to touch-sensitive display system **112**. Touch-sensitive display system **112** displays visual output to the user. The visual output optionally includes graphics, text, icons, video, and any combination thereof (collectively termed "graphics"). In some embodiments, some or all of the visual output corresponds to user interface objects. As used herein, the term "affordance" refers to a user-interactive graphical user interface object (e.g., a graphical user interface object that is configured to respond to inputs directed toward the graphical user interface object). Examples of user-interactive graphical user interface objects include, without limitation, a button, slider, icon, selectable menu item, switch, hyperlink, or other user interface control.

Touch-sensitive display system **112** has a touch-sensitive surface, sensor or set of sensors that accepts input from the user based on haptic and/or tactile contact. Touch-sensitive display system **112** and display controller **156** (along with any associated modules and/or sets of instructions in memory **102**) detect contact (and any movement or breaking of the contact) on touch-sensitive display system **112** and converts the detected contact into interaction with user-interface objects (e.g., one or more soft keys, icons, web pages or images) that are displayed on touch-sensitive display system **112**. In some embodiments, a point of contact between touch-sensitive display system **112** and the user corresponds to a finger of the user or a stylus.

Touch-sensitive display system **112** optionally uses LCD (liquid crystal display) technology, LPD (light emitting polymer display) technology, or LED (light emitting diode) technology, although other display technologies are used in other embodiments. Touch-sensitive display system **112** and display controller **156** optionally detect contact and any movement or breaking thereof using any of a plurality of touch sensing technologies now known or later developed, including but not limited to capacitive, resistive, infrared, and surface acoustic wave technologies, as well as other proximity sensor arrays or other elements for determining one or more points of contact with touch-sensitive display system **112**. In some embodiments, projected mutual capacitance sensing technology is used, such as that found in the iPhone®, iPod Touch®, and iPad® from Apple Inc. of Cupertino, Calif.

Touch-sensitive display system **112** optionally has a video resolution in excess of 100 dpi. In some embodiments, the touch screen video resolution is in excess of 400 dpi (e.g., 500 dpi, 800 dpi, or greater). The user optionally makes contact with touch-sensitive display system **112** using any suitable object or appendage, such as a stylus, a finger, and so forth. In some embodiments, the user interface is designed to work with finger-based contacts and gestures, which can be less precise than stylus-based input due to the larger area of contact of a finger on the touch screen. In some embodiments, the device translates the rough finger-based input into a precise pointer/cursor position or command for performing the actions desired by the user.

In some embodiments, in addition to the touch screen, device **100** optionally includes a touchpad (not shown) for activating or deactivating particular functions. In some embodiments, the touchpad is a touch-sensitive area of the device that, unlike the touch screen, does not display visual output. The touchpad is, optionally, a touch-sensitive surface that is separate from touch-sensitive display system **112** or an extension of the touch-sensitive surface formed by the touch screen.

Device **100** also includes power system **162** for powering the various components. Power system **162** optionally includes a power management system, one or more power sources (e.g., battery, alternating current (AC)), a recharging system, a power failure detection circuit, a power converter or inverter, a power status indicator (e.g., a light-emitting diode (LED)) and any other components associated with the generation, management and distribution of power in portable devices.

Device **100** optionally also includes one or more optical sensors **164**. FIG. **1**A shows an optical sensor coupled with optical sensor controller **158** in I/O subsystem **106**. Optical sensor(s) **164** optionally include charge-coupled device (CCD) or complementary metal-oxide semiconductor (CMOS) phototransistors. Optical sensor(s) **164** receive light from the environment, projected through one or more lens, and converts the light to data representing an image. In conjunction with imaging module **143** (also called a camera module), optical sensor(s) **164** optionally capture still images and/or video. In some embodiments, an optical sensor is located on the back of device **100**, opposite touch-sensitive display system **112** on the front of the device, so that the touch screen is enabled for use as a viewfinder for still and/or video image acquisition. In some embodiments, another optical sensor is located on the front of the device so that the user's image is obtained (e.g., for selfies, for videoconferencing while the user views the other video conference participants on the touch screen, etc.).

Device **100** optionally also includes one or more contact intensity sensors **165**. FIG. **1**A shows a contact intensity sensor coupled with intensity sensor controller **159** in I/O subsystem **106**. Contact intensity sensor(s) **165** optionally include one or more piezoresistive strain gauges, capacitive force sensors, electric force sensors, piezoelectric force sensors, optical force sensors, capacitive touch-sensitive surfaces, or other intensity sensors (e.g., sensors used to measure the force (or pressure) of a contact on a touch-sensitive surface). Contact intensity sensor(s) **165** receive contact intensity information (e.g., pressure information or a proxy for pressure information) from the environment. In some embodiments, at least one contact intensity sensor is collocated with, or proximate to, a touch-sensitive surface

(e.g., touch-sensitive display system **112**). In some embodiments, at least one contact intensity sensor is located on the back of device **100**, opposite touch-screen display system **112** which is located on the front of device **100**.

Device **100** optionally also includes one or more proximity sensors **166**. FIG. **1**A shows proximity sensor **166** coupled with peripherals interface **118**. Alternately, proximity sensor **166** is coupled with input controller **160** in I/O subsystem **106**. In some embodiments, the proximity sensor turns off and disables touch-sensitive display system **112** when the multifunction device is placed near the user's ear (e.g., when the user is making a phone call).

Device **100** optionally also includes one or more tactile output generators **167**. FIG. **1**A shows a tactile output generator coupled with haptic feedback controller **161** in I/O subsystem **106**. In some embodiments, tactile output generator(s) **167** include one or more electroacoustic devices such as speakers or other audio components and/or electromechanical devices that convert energy into linear motion such as a motor, solenoid, electroactive polymer, piezoelectric actuator, electrostatic actuator, or other tactile output generating component (e.g., a component that converts electrical signals into tactile outputs on the device). Tactile output generator(s) **167** receive tactile feedback generation instructions from haptic feedback module **133** and generates tactile outputs on device **100** that are capable of being sensed by a user of device **100**. In some embodiments, at least one tactile output generator is collocated with, or proximate to, a touch-sensitive surface (e.g., touch-sensitive display system **112**) and, optionally, generates a tactile output by moving the touch-sensitive surface vertically (e.g., in/out of a surface of device **100**) or laterally (e.g., back and forth in the same plane as a surface of device **100**). In some embodiments, at least one tactile output generator sensor is located on the back of device **100**, opposite touch-sensitive display system **112**, which is located on the front of device **100**.

Device **100** optionally also includes one or more accelerometers **168**. FIG. **1**A shows accelerometer **168** coupled with peripherals interface **118**. Alternately, accelerometer **168** is, optionally, coupled with an input controller **160** in I/O subsystem **106**. In some embodiments, information is displayed on the touch-screen display in a portrait view or a landscape view based on an analysis of data received from the one or more accelerometers. Device **100** optionally includes, in addition to accelerometer(s) **168**, a magnetometer (not shown) and a GPS (or GLONASS or other global navigation system) receiver (not shown) for obtaining information concerning the location and orientation (e.g., portrait or landscape) of device **100**.

In some embodiments, the software components stored in memory **102** include operating system **126**, communication module (or set of instructions) **128**, contact/motion module (or set of instructions) **130**, graphics module (or set of instructions) **132**, haptic feedback module (or set of instructions) **133**, text input module (or set of instructions) **134**, Global Positioning System (GPS) module (or set of instructions) **135**, and applications (or sets of instructions) **136**. Furthermore, in some embodiments, memory **102** stores device/global internal state **157**, as shown in FIGS. **1**A and **3**. Device/global internal state **157** includes one or more of: active application state, indicating which applications, if any, are currently active; display state, indicating what applications, views or other information occupy various regions of touch-sensitive display system **112**; sensor state, including information obtained from the device's various sensors and other input or control devices **116**; and location and/or positional information concerning the device's location and/or attitude.

Operating system **126** (e.g., iOS, Darwin, RTXC, LINUX, UNIX, OS X, WINDOWS, or an embedded operating system such as VxWorks) includes various software components and/or drivers for controlling and managing general system tasks (e.g., memory management, storage device control, power management, etc.) and facilitates communication between various hardware and software components.

Communication module **128** facilitates communication with other devices over one or more external ports **124** and also includes various software components for handling data received by RF circuitry **108** and/or external port **124**. External port **124** (e.g., Universal Serial Bus (USB), FIREWIRE, etc.) is adapted for coupling directly to other devices or indirectly over a network (e.g., the Internet, wireless LAN, etc.). In some embodiments, the external port is a multi-pin (e.g., 30-pin) connector that is the same as, or similar to and/or compatible with the 30-pin connector used in some iPhone®, iPod Touch®, and iPad® devices from Apple Inc. of Cupertino, Calif. In some embodiments, the external port is a Lightning connector that is the same as, or similar to and/or compatible with the Lightning connector used in some iPhone®, iPod Touch®, and iPad® devices from Apple Inc. of Cupertino, Calif.

Contact/motion module **130** optionally detects contact with touch-sensitive display system **112** (in conjunction with display controller **156**) and other touch-sensitive devices (e.g., a touchpad or physical click wheel). Contact/motion module **130** includes various software components for performing various operations related to detection of contact (e.g., by a finger or by a stylus), such as determining if contact has occurred (e.g., detecting a finger-down event), determining an intensity of the contact (e.g., the force or pressure of the contact or a substitute for the force or pressure of the contact), determining if there is movement of the contact and tracking the movement across the touch-sensitive surface (e.g., detecting one or more finger-dragging events), and determining if the contact has ceased (e.g., detecting a finger-up event or a break in contact). Contact/motion module **130** receives contact data from the touch-sensitive surface. Determining movement of the point of contact, which is represented by a series of contact data, optionally includes determining speed (magnitude), velocity (magnitude and direction), and/or an acceleration (a change in magnitude and/or direction) of the point of contact. These operations are, optionally, applied to single contacts (e.g., one finger contacts or stylus contacts) or to multiple simultaneous contacts (e.g., "multitouch"/multiple finger contacts). In some embodiments, contact/motion module **130** and display controller **156** detect contact on a touchpad.

Contact/motion module **130** optionally detects a gesture input by a user. Different gestures on the touch-sensitive surface have different contact patterns (e.g., different motions, timings, and/or intensities of detected contacts). Thus, a gesture is, optionally, detected by detecting a particular contact pattern. For example, detecting a finger tap gesture includes detecting a finger-down event followed by detecting a finger-up (lift off) event at the same position (or substantially the same position) as the finger-down event (e.g., at the position of an icon). As another example, detecting a finger swipe gesture on the touch-sensitive surface includes detecting a finger-down event followed by detecting one or more finger-dragging events, and subsequently followed by detecting a finger-up (lift off) event.

Similarly, tap, swipe, drag, and other gestures are optionally detected for a stylus by detecting a particular contact pattern for the stylus.

In some embodiments, detecting a finger tap gesture depends on the length of time between detecting the finger-down event and the finger-up event, but is independent of the intensity of the finger contact between detecting the finger-down event and the finger-up event. In some embodiments, a tap gesture is detected in accordance with a determination that the length of time between the finger-down event and the finger-up event is less than a predetermined value (e.g., less than 0.1, 0.2, 0.3, 0.4 or 0.5 seconds), independent of whether the intensity of the finger contact during the tap meets a given intensity threshold (greater than a nominal contact-detection intensity threshold), such as a light press or deep press intensity threshold. Thus, a finger tap gesture can satisfy particular input criteria that do not require that the characteristic intensity of a contact satisfy a given intensity threshold in order for the particular input criteria to be met. For clarity, the finger contact in a tap gesture typically needs to satisfy a nominal contact-detection intensity threshold, below which the contact is not detected, in order for the finger-down event to be detected. A similar analysis applies to detecting a tap gesture by a stylus or other contact. In cases where the device is capable of detecting a finger or stylus contact hovering over a touch sensitive surface, the nominal contact-detection intensity threshold optionally does not correspond to physical contact between the finger or stylus and the touch sensitive surface.

The same concepts apply in an analogous manner to other types of gestures. For example, a swipe gesture, a pinch gesture, a depinch gesture, and/or a long press gesture are optionally detected based on the satisfaction of criteria that are either independent of intensities of contacts included in the gesture, or do not require that contact(s) that perform the gesture reach intensity thresholds in order to be recognized. For example, a swipe gesture is detected based on an amount of movement of one or more contacts; a pinch gesture is detected based on movement of two or more contacts towards each other; a depinch gesture is detected based on movement of two or more contacts away from each other; and a long press gesture is detected based on a duration of the contact on the touch-sensitive surface with less than a threshold amount of movement. As such, the statement that particular gesture recognition criteria do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the particular gesture recognition criteria to be met means that the particular gesture recognition criteria are capable of being satisfied if the contact(s) in the gesture do not reach the respective intensity threshold, and are also capable of being satisfied in circumstances where one or more of the contacts in the gesture do reach or exceed the respective intensity threshold. In some embodiments, a tap gesture is detected based on a determination that the finger-down and finger-up event are detected within a predefined time period, without regard to whether the contact is above or below the respective intensity threshold during the predefined time period, and a swipe gesture is detected based on a determination that the contact movement is greater than a predefined magnitude, even if the contact is above the respective intensity threshold at the end of the contact movement. Even in implementations where detection of a gesture is influenced by the intensity of contacts performing the gesture (e.g., the device detects a long press more quickly when the intensity of the contact is above an intensity threshold or delays detection of a tap input when the intensity of the contact is higher), the detection of those gestures does not require that the contacts reach a particular intensity threshold so long as the criteria for recognizing the gesture can be met in circumstances where the contact does not reach the particular intensity threshold (e.g., even if the amount of time that it takes to recognize the gesture changes).

Contact intensity thresholds, duration thresholds, and movement thresholds are, in some circumstances, combined in a variety of different combinations in order to create heuristics for distinguishing two or more different gestures directed to the same input element or region so that multiple different interactions with the same input element are enabled to provide a richer set of user interactions and responses. The statement that a particular set of gesture recognition criteria do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the particular gesture recognition criteria to be met does not preclude the concurrent evaluation of other intensity-dependent gesture recognition criteria to identify other gestures that do have a criteria that is met when a gesture includes a contact with an intensity above the respective intensity threshold. For example, in some circumstances, first gesture recognition criteria for a first gesture—which do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the first gesture recognition criteria to be met—are in competition with second gesture recognition criteria for a second gesture—which are dependent on the contact(s) reaching the respective intensity threshold. In such competitions, the gesture is, optionally, not recognized as meeting the first gesture recognition criteria for the first gesture if the second gesture recognition criteria for the second gesture are met first. For example, if a contact reaches the respective intensity threshold before the contact moves by a predefined amount of movement, a deep press gesture is detected rather than a swipe gesture. Conversely, if the contact moves by the predefined amount of movement before the contact reaches the respective intensity threshold, a swipe gesture is detected rather than a deep press gesture. Even in such circumstances, the first gesture recognition criteria for the first gesture still do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the first gesture recognition criteria to be met because if the contact stayed below the respective intensity threshold until an end of the gesture (e.g., a swipe gesture with a contact that does not increase to an intensity above the respective intensity threshold), the gesture would have been recognized by the first gesture recognition criteria as a swipe gesture. As such, particular gesture recognition criteria that do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the particular gesture recognition criteria to be met will (A) in some circumstances ignore the intensity of the contact with respect to the intensity threshold (e.g. for a tap gesture) and/or (B) in some circumstances still be dependent on the intensity of the contact with respect to the intensity threshold in the sense that the particular gesture recognition criteria (e.g., for a long press gesture) will fail if a competing set of intensity-dependent gesture recognition criteria (e.g., for a deep press gesture) recognize an input as corresponding to an intensity-dependent gesture before the particular gesture recognition criteria recognize a gesture corresponding to the input (e.g., for a long press gesture that is competing with a deep press gesture for recognition).

Graphics module **132** includes various known software components for rendering and displaying graphics on touch-sensitive display system **112** or other display, including components for changing the visual impact (e.g., brightness,

transparency, saturation, contrast or other visual property) of graphics that are displayed. As used herein, the term "graphics" includes any object that can be displayed to a user, including without limitation text, web pages, icons (such as user-interface objects including soft keys), digital images, videos, animations and the like.

In some embodiments, graphics module **132** stores data representing graphics to be used. Each graphic is, optionally, assigned a corresponding code. Graphics module **132** receives, from applications etc., one or more codes specifying graphics to be displayed along with, if necessary, coordinate data and other graphic property data, and then generates screen image data to output to display controller **156**.

Haptic feedback module **133** includes various software components for generating instructions (e.g., instructions used by haptic feedback controller **161**) to produce tactile outputs using tactile output generator(s) **167** at one or more locations on device **100** in response to user interactions with device **100**.

Text input module **134**, which is, optionally, a component of graphics module **132**, provides soft keyboards for entering text in various applications (e.g., contacts **137**, e-mail **140**, IM **141**, browser **147**, and any other application that needs text input).

GPS module **135** determines the location of the device and provides this information for use in various applications (e.g., to telephone **138** for use in location-based dialing, to camera **143** as picture/video metadata, and to applications that provide location-based services such as weather mini applications, local yellow page mini applications, and map/navigation mini applications).

Applications **136** optionally include the following modules (or sets of instructions), or a subset or superset thereof:

- contacts module **137** (sometimes called an address book or contact list);
- telephone module **138**;
- video conferencing module **139**;
- e-mail client module **140**;
- instant messaging (IM) module **141**;
- workout support module **142**;
- camera module **143** for still and/or video images;
- image management module **144**;
- browser module **147**;
- calendar module **148**;
- mini application modules **149**, which optionally include one or more of: weather mini application **149-1**, stocks mini application **149-2**, calculator mini application **149-3**, alarm clock mini application **149-4**, dictionary mini application **149-5**, and other mini applications obtained by the user, as well as user-created mini applications **149-6**;
- mini application creator module **150** for making user-created mini applications **149-6**;
- search module **151**;
- video and music player module **152**, which is, optionally, made up of a video player module and a music player module;
- notes module **153**;
- map module **154**; and/or
- online video module **155**.

Examples of other applications **136** that are, optionally, stored in memory **102** include other word processing applications, other image editing applications, drawing applications, presentation applications, JAVA-enabled applications, encryption, digital rights management, voice recognition, and voice replication.

In conjunction with touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, contacts module **137** includes executable instructions to manage an address book or contact list (e.g., stored in application internal state **192** of contacts module **137** in memory **102** or memory **370**), including: adding name(s) to the address book; deleting name(s) from the address book; associating telephone number(s), e-mail address(es), physical address(es) or other information with a name; associating an image with a name; categorizing and sorting names; providing telephone numbers and/or e-mail addresses to initiate and/or facilitate communications by telephone **138**, video conference **139**, e-mail **140**, or IM **141**; and so forth.

In conjunction with RF circuitry **108**, audio circuitry **110**, speaker **111**, microphone **113**, touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, telephone module **138** includes executable instructions to enter a sequence of characters corresponding to a telephone number, access one or more telephone numbers in address book **137**, modify a telephone number that has been entered, dial a respective telephone number, conduct a conversation and disconnect or hang up when the conversation is completed. As noted above, the wireless communication optionally uses any of a plurality of communications standards, protocols and technologies.

In conjunction with RF circuitry **108**, audio circuitry **110**, speaker **111**, microphone **113**, touch-sensitive display system **112**, display controller **156**, optical sensor(s) **164**, optical sensor controller **158**, contact module **130**, graphics module **132**, text input module **134**, contact list **137**, and telephone module **138**, videoconferencing module **139** includes executable instructions to initiate, conduct, and terminate a video conference between a user and one or more other participants in accordance with user instructions.

In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, e-mail client module **140** includes executable instructions to create, send, receive, and manage e-mail in response to user instructions. In conjunction with image management module **144**, e-mail client module **140** makes it very easy to create and send e-mails with still or video images taken with camera module **143**.

In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, the instant messaging module **141** includes executable instructions to enter a sequence of characters corresponding to an instant message, to modify previously entered characters, to transmit a respective instant message (for example, using a Short Message Service (SMS) or Multimedia Message Service (MMS) protocol for telephony-based instant messages or using XMPP, SIMPLE, Apple Push Notification Service (APNs) or IMPS for Internet-based instant messages), to receive instant messages, and to view received instant messages. In some embodiments, transmitted and/or received instant messages optionally include graphics, photos, audio files, video files and/or other attachments as are supported in a MMS and/or an Enhanced Messaging Service (EMS). As used herein, "instant messaging" refers to both telephony-based messages (e.g., messages sent using SMS or MMS) and Internet-based messages (e.g., messages sent using XMPP, SIMPLE, APNs, or IMPS).

In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display controller **156**, contact module

130, graphics module **132**, text input module **134**, GPS module **135**, map module **154**, and video and music player module **152**, workout support module **142** includes executable instructions to create workouts (e.g., with time, distance, and/or calorie burning goals); communicate with workout sensors (in sports devices and smart watches); receive workout sensor data; calibrate sensors used to monitor a workout; select and play music for a workout; and display, store and transmit workout data.

In conjunction with touch-sensitive display system **112**, display controller **156**, optical sensor(s) **164**, optical sensor controller **158**, contact module **130**, graphics module **132**, and image management module **144**, camera module **143** includes executable instructions to capture still images or video (including a video stream) and store them into memory **102**, modify characteristics of a still image or video, and/or delete a still image or video from memory **102**.

In conjunction with touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, text input module **134**, and camera module **143**, image management module **144** includes executable instructions to arrange, modify (e.g., edit), or otherwise manipulate, label, delete, present (e.g., in a digital slide show or album), and store still and/or video images.

In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, and text input module **134**, browser module **147** includes executable instructions to browse the Internet in accordance with user instructions, including searching, linking to, receiving, and displaying web pages or portions thereof, as well as attachments and other files linked to web pages.

In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, e-mail client module **140**, and browser module **147**, calendar module **148** includes executable instructions to create, display, modify, and store calendars and data associated with calendars (e.g., calendar entries, to do lists, etc.) in accordance with user instructions.

In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, and browser module **147**, mini application modules **149** are mini-applications that are, optionally, downloaded and used by a user (e.g., weather mini application **149-1**, stocks mini application **149-2**, calculator mini application **149-3**, alarm clock mini application **149-4**, and dictionary mini application **149-5**) or created by the user (e.g., user-created mini application **149-6**). In some embodiments, a mini application includes an HTML (Hypertext Markup Language) file, a CSS (Cascading Style Sheets) file, and a JavaScript file. In some embodiments, a mini application includes an XML (Extensible Markup Language) file and a JavaScript file (e.g., Yahoo! Mini applications).

In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, and browser module **147**, the mini application creator module **150** includes executable instructions to create mini applications (e.g., turning a user-specified portion of a web page into a mini application).

In conjunction with touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, and text input module **134**, search module **151** includes executable instructions to search for text, music, sound, image, video, and/or other files in memory **102** that match one or more search criteria (e.g., one or more user-specified search terms) in accordance with user instructions.

In conjunction with touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, audio circuitry **110**, speaker **111**, RF circuitry **108**, and browser module **147**, video and music player module **152** includes executable instructions that allow the user to download and play back recorded music and other sound files stored in one or more file formats, such as MP3 or AAC files, and executable instructions to display, present or otherwise play back videos (e.g., on touch-sensitive display system **112**, or on an external display connected wirelessly or via external port **124**). In some embodiments, device **100** optionally includes the functionality of an MP3 player, such as an iPod (trademark of Apple Inc.).

In conjunction with touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, notes module **153** includes executable instructions to create and manage notes, to do lists, and the like in accordance with user instructions.

In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, GPS module **135**, and browser module **147**, map module **154** includes executable instructions to receive, display, modify, and store maps and data associated with maps (e.g., driving directions; data on stores and other points of interest at or near a particular location; and other location-based data) in accordance with user instructions.

In conjunction with touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, audio circuitry **110**, speaker **111**, RF circuitry **108**, text input module **134**, e-mail client module **140**, and browser module **147**, online video module **155** includes executable instructions that allow the user to access, browse, receive (e.g., by streaming and/or download), play back (e.g., on the touch screen **112**, or on an external display connected wirelessly or via external port **124**), send an e-mail with a link to a particular online video, and otherwise manage online videos in one or more file formats, such as H.264. In some embodiments, instant messaging module **141**, rather than e-mail client module **140**, is used to send a link to a particular online video.

Each of the above identified modules and applications correspond to a set of executable instructions for performing one or more functions described above and the methods described in this application (e.g., the computer-implemented methods and other information processing methods described herein). These modules (i.e., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules are, optionally, combined or otherwise re-arranged in various embodiments. In some embodiments, memory **102** optionally stores a subset of the modules and data structures identified above. Furthermore, memory **102** optionally stores additional modules and data structures not described above.

In some embodiments, device **100** is a device where operation of a predefined set of functions on the device is performed exclusively through a touch screen and/or a touchpad. By using a touch screen and/or a touchpad as the primary input control device for operation of device **100**, the number of physical input control devices (such as push buttons, dials, and the like) on device **100** is, optionally, reduced.

The predefined set of functions that are performed exclusively through a touch screen and/or a touchpad optionally

include navigation between user interfaces. In some embodiments, the touchpad, when touched by the user, navigates device **100** to a main, home, or root menu from any user interface that is displayed on device **100**. In such embodiments, a "menu button" is implemented using a touchpad. In some other embodiments, the menu button is a physical push button or other physical input control device instead of a touchpad.

FIG. **1B** is a block diagram illustrating example components for event handling in accordance with some embodiments. In some embodiments, memory **102** (in FIG. **1A**) or **370** (FIG. **3**) includes event sorter **170** (e.g., in operating system **126**) and a respective application **136-1** (e.g., any of the aforementioned applications **136**, **137-155**, **380-390**).

Event sorter **170** receives event information and determines the application **136-1** and application view **191** of application **136-1** to which to deliver the event information. Event sorter **170** includes event monitor **171** and event dispatcher module **174**. In some embodiments, application **136-1** includes application internal state **192**, which indicates the current application view(s) displayed on touch-sensitive display system **112** when the application is active or executing. In some embodiments, device/global internal state **157** is used by event sorter **170** to determine which application(s) is (are) currently active, and application internal state **192** is used by event sorter **170** to determine application views **191** to which to deliver event information.

In some embodiments, application internal state **192** includes additional information, such as one or more of: resume information to be used when application **136-1** resumes execution, user interface state information that indicates information being displayed or that is ready for display by application **136-1**, a state queue for enabling the user to go back to a prior state or view of application **136-1**, and a redo/undo queue of previous actions taken by the user.

Event monitor **171** receives event information from peripherals interface **118**. Event information includes information about a sub-event (e.g., a user touch on touch-sensitive display system **112**, as part of a multi-touch gesture). Peripherals interface **118** transmits information it receives from I/O subsystem **106** or a sensor, such as proximity sensor **166**, accelerometer(s) **168**, and/or microphone **113** (through audio circuitry **110**). Information that peripherals interface **118** receives from I/O subsystem **106** includes information from touch-sensitive display system **112** or a touch-sensitive surface.

In some embodiments, event monitor **171** sends requests to the peripherals interface **118** at predetermined intervals. In response, peripherals interface **118** transmits event information. In other embodiments, peripheral interface **118** transmits event information only when there is a significant event (e.g., receiving an input above a predetermined noise threshold and/or for more than a predetermined duration).

In some embodiments, event sorter **170** also includes a hit view determination module **172** and/or an active event recognizer determination module **173**.

Hit view determination module **172** provides software procedures for determining where a sub-event has taken place within one or more views, when touch-sensitive display system **112** displays more than one view. Views are made up of controls and other elements that a user can see on the display.

Another aspect of the user interface associated with an application is a set of views, sometimes herein called application views or user interface windows, in which information is displayed and touch-based gestures occur. The application views (of a respective application) in which a touch is detected optionally correspond to programmatic levels within a programmatic or view hierarchy of the application. For example, the lowest level view in which a touch is detected is, optionally, called the hit view, and the set of events that are recognized as proper inputs are, optionally, determined based, at least in part, on the hit view of the initial touch that begins a touch-based gesture.

Hit view determination module **172** receives information related to sub-events of a touch-based gesture. When an application has multiple views organized in a hierarchy, hit view determination module **172** identifies a hit view as the lowest view in the hierarchy which should handle the sub-event. In most circumstances, the hit view is the lowest level view in which an initiating sub-event occurs (i.e., the first sub-event in the sequence of sub-events that form an event or potential event). Once the hit view is identified by the hit view determination module, the hit view typically receives all sub-events related to the same touch or input source for which it was identified as the hit view.

Active event recognizer determination module **173** determines which view or views within a view hierarchy should receive a particular sequence of sub-events. In some embodiments, active event recognizer determination module **173** determines that only the hit view should receive a particular sequence of sub-events. In other embodiments, active event recognizer determination module **173** determines that all views that include the physical location of a sub-event are actively involved views, and therefore determines that all actively involved views should receive a particular sequence of sub-events. In other embodiments, even if touch sub-events were entirely confined to the area associated with one particular view, views higher in the hierarchy would still remain as actively involved views.

Event dispatcher module **174** dispatches the event information to an event recognizer (e.g., event recognizer **180**). In embodiments including active event recognizer determination module **173**, event dispatcher module **174** delivers the event information to an event recognizer determined by active event recognizer determination module **173**. In some embodiments, event dispatcher module **174** stores in an event queue the event information, which is retrieved by a respective event receiver module **182**.

In some embodiments, operating system **126** includes event sorter **170**. Alternatively, application **136-1** includes event sorter **170**. In yet other embodiments, event sorter **170** is a stand-alone module, or a part of another module stored in memory **102**, such as contact/motion module **130**.

In some embodiments, application **136-1** includes a plurality of event handlers **190** and one or more application views **191**, each of which includes instructions for handling touch events that occur within a respective view of the application's user interface. Each application view **191** of the application **136-1** includes one or more event recognizers **180**. Typically, a respective application view **191** includes a plurality of event recognizers **180**. In other embodiments, one or more of event recognizers **180** are part of a separate module, such as a user interface kit (not shown) or a higher level object from which application **136-1** inherits methods and other properties. In some embodiments, a respective event handler **190** includes one or more of: data updater **176**, object updater **177**, GUI updater **178**, and/or event data **179** received from event sorter **170**. Event handler **190** optionally utilizes or calls data updater **176**, object updater **177** or GUI updater **178** to update the application internal state **192**. Alternatively, one or more of the application views **191** includes one or more respective event handlers **190**. Also, in some embodiments, one or

more of data updater **176**, object updater **177**, and GUI updater **178** are included in a respective application view **191**.

A respective event recognizer **180** receives event information (e.g., event data **179**) from event sorter **170**, and identifies an event from the event information. Event recognizer **180** includes event receiver **182** and event comparator **184**. In some embodiments, event recognizer **180** also includes at least a subset of: metadata **183**, and event delivery instructions **188** (which optionally include sub-event delivery instructions).

Event receiver **182** receives event information from event sorter **170**. The event information includes information about a sub-event, for example, a touch or a touch movement. Depending on the sub-event, the event information also includes additional information, such as location of the sub-event. When the sub-event concerns motion of a touch, the event information optionally also includes speed and direction of the sub-event. In some embodiments, events include rotation of the device from one orientation to another (e.g., from a portrait orientation to a landscape orientation, or vice versa), and the event information includes corresponding information about the current orientation (also called device attitude) of the device.

Event comparator **184** compares the event information to predefined event or sub-event definitions and, based on the comparison, determines an event or sub-event, or determines or updates the state of an event or sub-event. In some embodiments, event comparator **184** includes event definitions **186**. Event definitions **186** contain definitions of events (e.g., predefined sequences of sub-events), for example, event **1** (**187-1**), event **2** (**187-2**), and others. In some embodiments, sub-events in an event **187** include, for example, touch begin, touch end, touch movement, touch cancellation, and multiple touching. In one example, the definition for event **1** (**187-1**) is a double tap on a displayed object. The double tap, for example, comprises a first touch (touch begin) on the displayed object for a predetermined phase, a first lift-off (touch end) for a predetermined phase, a second touch (touch begin) on the displayed object for a predetermined phase, and a second lift-off (touch end) for a predetermined phase. In another example, the definition for event **2** (**187-2**) is a dragging on a displayed object. The dragging, for example, comprises a touch (or contact) on the displayed object for a predetermined phase, a movement of the touch across touch-sensitive display system **112**, and lift-off of the touch (touch end). In some embodiments, the event also includes information for one or more associated event handlers **190**.

In some embodiments, event definition **187** includes a definition of an event for a respective user-interface object. In some embodiments, event comparator **184** performs a hit test to determine which user-interface object is associated with a sub-event. For example, in an application view in which three user-interface objects are displayed on touch-sensitive display system **112**, when a touch is detected on touch-sensitive display system **112**, event comparator **184** performs a hit test to determine which of the three user-interface objects is associated with the touch (sub-event). If each displayed object is associated with a respective event handler **190**, the event comparator uses the result of the hit test to determine which event handler **190** should be activated. For example, event comparator **184** selects an event handler associated with the sub-event and the object triggering the hit test.

In some embodiments, the definition for a respective event **187** also includes delayed actions that delay delivery of the event information until after it has been determined whether the sequence of sub-events does or does not correspond to the event recognizer's event type.

When a respective event recognizer **180** determines that the series of sub-events do not match any of the events in event definitions **186**, the respective event recognizer **180** enters an event impossible, event failed, or event ended state, after which it disregards subsequent sub-events of the touch-based gesture. In this situation, other event recognizers, if any, that remain active for the hit view continue to track and process sub-events of an ongoing touch-based gesture.

In some embodiments, a respective event recognizer **180** includes metadata **183** with configurable properties, flags, and/or lists that indicate how the event delivery system should perform sub-event delivery to actively involved event recognizers. In some embodiments, metadata **183** includes configurable properties, flags, and/or lists that indicate how event recognizers interact, or are enabled to interact, with one another. In some embodiments, metadata **183** includes configurable properties, flags, and/or lists that indicate whether sub-events are delivered to varying levels in the view or programmatic hierarchy.

In some embodiments, a respective event recognizer **180** activates event handler **190** associated with an event when one or more particular sub-events of an event are recognized. In some embodiments, a respective event recognizer **180** delivers event information associated with the event to event handler **190**. Activating an event handler **190** is distinct from sending (and deferred sending) sub-events to a respective hit view. In some embodiments, event recognizer **180** throws a flag associated with the recognized event, and event handler **190** associated with the flag catches the flag and performs a predefined process.

In some embodiments, event delivery instructions **188** include sub-event delivery instructions that deliver event information about a sub-event without activating an event handler. Instead, the sub-event delivery instructions deliver event information to event handlers associated with the series of sub-events or to actively involved views. Event handlers associated with the series of sub-events or with actively involved views receive the event information and perform a predetermined process.

In some embodiments, data updater **176** creates and updates data used in application **136-1**. For example, data updater **176** updates the telephone number used in contacts module **137**, or stores a video file used in video and music player module **152**. In some embodiments, object updater **177** creates and updates objects used in application **136-1**. For example, object updater **177** creates a new user-interface object or updates the position of a user-interface object. GUI updater **178** updates the GUI. For example, GUI updater **178** prepares display information and sends it to graphics module **132** for display on a touch-sensitive display.

In some embodiments, event handler(s) **190** includes or has access to data updater **176**, object updater **177**, and GUI updater **178**. In some embodiments, data updater **176**, object updater **177**, and GUI updater **178** are included in a single module of a respective application **136-1** or application view **191**. In other embodiments, they are included in two or more software modules.

It shall be understood that the foregoing discussion regarding event handling of user touches on touch-sensitive displays also applies to other forms of user inputs to operate multifunction devices **100** with input-devices, not all of which are initiated on touch screens. For example, mouse movement and mouse button presses, optionally coordinated

with single or multiple keyboard presses or holds; contact movements such as taps, drags, scrolls, etc., on touch-pads; pen stylus inputs; movement of the device; oral instructions; detected eye movements; biometric inputs; and/or any combination thereof are optionally utilized as inputs corresponding to sub-events which define an event to be recognized.

FIG. **1**C is a block diagram illustrating a tactile output module in accordance with some embodiments. In some embodiments, I/O subsystem **106** (e.g., haptic feedback controller **161** (FIG. **1**A) and/or other input controller(s) **160** (FIG. **1**A)) includes at least some of the example components shown in FIG. **1**C. In some embodiments, peripherals interface **118** includes at least some of the example components shown in FIG. **1**C.

In some embodiments, the tactile output module includes haptic feedback module **133**. In some embodiments, haptic feedback module **133** aggregates and combines tactile outputs for user interface feedback from software applications on the electronic device (e.g., feedback that is responsive to user inputs that correspond to displayed user interfaces and alerts and other notifications that indicate the performance of operations or occurrence of events in user interfaces of the electronic device). Haptic feedback module **133** includes one or more of: waveform module **123** (for providing waveforms used for generating tactile outputs), mixer **125** (for mixing waveforms, such as waveforms in different channels), compressor **127** (for reducing or compressing a dynamic range of the waveforms), low-pass filter **129** (for filtering out high frequency signal components in the waveforms), and thermal controller **131** (for adjusting the waveforms in accordance with thermal conditions). In some embodiments, haptic feedback module **133** is included in haptic feedback controller **161** (FIG. **1**A). In some embodiments, a separate unit of haptic feedback module **133** (or a separate implementation of haptic feedback module **133**) is also included in an audio controller (e.g., audio circuitry **110**, FIG. **1**A) and used for generating audio signals. In some embodiments, a single haptic feedback module **133** is used for generating audio signals and generating waveforms for tactile outputs.

In some embodiments, haptic feedback module **133** also includes trigger module **121** (e.g., a software application, operating system, or other software module that determines a tactile output is to be generated and initiates the process for generating the corresponding tactile output). In some embodiments, trigger module **121** generates trigger signals for initiating generation of waveforms (e.g., by waveform module **123**). For example, trigger module **121** generates trigger signals based on preset timing criteria. In some embodiments, trigger module **121** receives trigger signals from outside haptic feedback module **133** (e.g., in some embodiments, haptic feedback module **133** receives trigger signals from hardware input processing module **146** located outside haptic feedback module **133**) and relays the trigger signals to other components within haptic feedback module **133** (e.g., waveform module **123**) or software applications that trigger operations (e.g., with trigger module **121**) based on activation of a user interface element (e.g., an application icon or an affordance within an application) or a hardware input device (e.g., a home button or an intensity-sensitive input surface, such as an intensity-sensitive touch screen). In some embodiments, trigger module **121** also receives tactile feedback generation instructions (e.g., from haptic feedback module **133**, FIGS. **1**A and **3**). In some embodiments, trigger module **121** generates trigger signals in response to haptic feedback module **133** (or trigger module **121** in haptic

feedback module **133**) receiving tactile feedback instructions (e.g., from haptic feedback module **133**, FIGS. **1**A and **3**).

Waveform module **123** receives trigger signals (e.g., from trigger module **121**) as an input, and in response to receiving trigger signals, provides waveforms for generation of one or more tactile outputs (e.g., waveforms selected from a predefined set of waveforms designated for use by waveform module **123**, such as the waveforms described in greater detail below with reference to FIGS. **4**F-**4**G).

Mixer **125** receives waveforms (e.g., from waveform module **123**) as an input, and mixes together the waveforms. For example, when mixer **125** receives two or more waveforms (e.g., a first waveform in a first channel and a second waveform that at least partially overlaps with the first waveform in a second channel) mixer **125** outputs a combined waveform that corresponds to a sum of the two or more waveforms. In some embodiments, mixer **125** also modifies one or more waveforms of the two or more waveforms to emphasize particular waveform(s) over the rest of the two or more waveforms (e.g., by increasing a scale of the particular waveform(s) and/or decreasing a scale of the rest of the waveforms). In some circumstances, mixer **125** selects one or more waveforms to remove from the combined waveform (e.g., the waveform from the oldest source is dropped when there are waveforms from more than three sources that have been requested to be output concurrently by tactile output generator **167**).

Compressor **127** receives waveforms (e.g., a combined waveform from mixer **125**) as an input, and modifies the waveforms. In some embodiments, compressor **127** reduces the waveforms (e.g., in accordance with physical specifications of tactile output generators **167** (FIG. **1**A) or **357** (FIG. **3**)) so that tactile outputs corresponding to the waveforms are reduced. In some embodiments, compressor **127** limits the waveforms, such as by enforcing a predefined maximum amplitude for the waveforms. For example, compressor **127** reduces amplitudes of portions of waveforms that exceed a predefined amplitude threshold while maintaining amplitudes of portions of waveforms that do not exceed the predefined amplitude threshold. In some embodiments, compressor **127** reduces a dynamic range of the waveforms. In some embodiments, compressor **127** dynamically reduces the dynamic range of the waveforms so that the combined waveforms remain within performance specifications of the tactile output generator **167** (e.g., force and/or moveable mass displacement limits).

Low-pass filter **129** receives waveforms (e.g., compressed waveforms from compressor **127**) as an input, and filters (e.g., smooths) the waveforms (e.g., removes or reduces high frequency signal components in the waveforms). For example, in some instances, compressor **127** includes, in compressed waveforms, extraneous signals (e.g., high frequency signal components) that interfere with the generation of tactile outputs and/or exceed performance specifications of tactile output generator **167** when the tactile outputs are generated in accordance with the compressed waveforms. Low-pass filter **129** reduces or removes such extraneous signals in the waveforms.

Thermal controller **131** receives waveforms (e.g., filtered waveforms from low-pass filter **129**) as an input, and adjusts the waveforms in accordance with thermal conditions of device **100** (e.g., based on internal temperatures detected within device **100**, such as the temperature of haptic feedback controller **161**, and/or external temperatures detected by device **100**). For example, in some cases, the output of haptic feedback controller **161** varies depending on the

temperature (e.g. haptic feedback controller **161**, in response to receiving same waveforms, generates a first tactile output when haptic feedback controller **161** is at a first temperature and generates a second tactile output when haptic feedback controller **161** is at a second temperature that is distinct from the first temperature). For example, the magnitude (or the amplitude) of the tactile outputs may vary depending on the temperature. To reduce the effect of the temperature variations, the waveforms are modified (e.g., an amplitude of the waveforms is increased or decreased based on the temperature).

In some embodiments, haptic feedback module **133** (e.g., trigger module **121**) is coupled to hardware input processing module **146**. In some embodiments, other input controller(s) **160** in FIG. **1**A includes hardware input processing module **146**. In some embodiments, hardware input processing module **146** receives inputs from hardware input device **145** (e.g., other input or control devices **116** in FIG. **1**A, such as a home button or an intensity-sensitive input surface, such as an intensity-sensitive touch screen). In some embodiments, hardware input device **145** is any input device described herein, such as touch-sensitive display system **112** (FIG. **1**A), keyboard/mouse **350** (FIG. **3**), touchpad **355** (FIG. **3**), one of other input or control devices **116** (FIG. **1**A), or an intensity-sensitive home button. In some embodiments, hardware input device **145** consists of an intensity-sensitive home button, and not touch-sensitive display system **112** (FIG. **1**A), keyboard/mouse **350** (FIG. **3**), or touchpad **355** (FIG. **3**). In some embodiments, in response to inputs from hardware input device **145** (e.g., an intensity-sensitive home button or a touch screen), hardware input processing module **146** provides one or more trigger signals to haptic feedback module **133** to indicate that a user input satisfying predefined input criteria, such as an input corresponding to a "click" of a home button (e.g., a "down click" or an "up click"), has been detected. In some embodiments, haptic feedback module **133** provides waveforms that correspond to the "click" of a home button in response to the input corresponding to the "click" of a home button, simulating a haptic feedback of pressing a physical home button.

In some embodiments, the tactile output module includes haptic feedback controller **161** (e.g., haptic feedback controller **161** in FIG. **1**A), which controls the generation of tactile outputs. In some embodiments, haptic feedback controller **161** is coupled to a plurality of tactile output generators, and selects one or more tactile output generators of the plurality of tactile output generators and sends waveforms to the selected one or more tactile output generators for generating tactile outputs. In some embodiments, haptic feedback controller **161** coordinates tactile output requests that correspond to activation of hardware input device **145** and tactile output requests that correspond to software events (e.g., tactile output requests from haptic feedback module **133**) and modifies one or more waveforms of the two or more waveforms to emphasize particular waveform(s) over the rest of the two or more waveforms (e.g., by increasing a scale of the particular waveform(s) and/or decreasing a scale of the rest of the waveforms, such as to prioritize tactile outputs that correspond to activations of hardware input device **145** over tactile outputs that correspond to software events).

In some embodiments, as shown in FIG. **1**C, an output of haptic feedback controller **161** is coupled to audio circuitry of device **100** (e.g., audio circuitry **110**, FIG. **1**A), and provides audio signals to audio circuitry of device **100**. In some embodiments, haptic feedback controller **161** provides both waveforms used for generating tactile outputs and audio signals used for providing audio outputs in conjunction with generation of the tactile outputs. In some embodiments, haptic feedback controller **161** modifies audio signals and/or waveforms (used for generating tactile outputs) so that the audio outputs and the tactile outputs are synchronized (e.g., by delaying the audio signals and/or waveforms). In some embodiments, haptic feedback controller **161** includes a digital-to-analog converter used for converting digital waveforms into analog signals, which are received by amplifier **163** and/or tactile output generator **167**.

In some embodiments, the tactile output module includes amplifier **163**. In some embodiments, amplifier **163** receives waveforms (e.g., from haptic feedback controller **161**) and amplifies the waveforms prior to sending the amplified waveforms to tactile output generator **167** (e.g., any of tactile output generators **167** (FIG. **1**A) or **357** (FIG. **3**)). For example, amplifier **163** amplifies the received waveforms to signal levels that are in accordance with physical specifications of tactile output generator **167** (e.g., to a voltage and/or a current required by tactile output generator **167** for generating tactile outputs so that the signals sent to tactile output generator **167** produce tactile outputs that correspond to the waveforms received from haptic feedback controller **161**) and sends the amplified waveforms to tactile output generator **167**. In response, tactile output generator **167** generates tactile outputs (e.g., by shifting a moveable mass back and forth in one or more dimensions relative to a neutral position of the moveable mass).

In some embodiments, the tactile output module includes sensor **169**, which is coupled to tactile output generator **167**. Sensor **169** detects states or state changes (e.g., mechanical position, physical displacement, and/or movement) of tactile output generator **167** or one or more components of tactile output generator **167** (e.g., one or more moving parts, such as a membrane, used to generate tactile outputs). In some embodiments, sensor **169** is a magnetic field sensor (e.g., a Hall effect sensor) or other displacement and/or movement sensor. In some embodiments, sensor **169** provides information (e.g., a position, a displacement, and/or a movement of one or more parts in tactile output generator **167**) to haptic feedback controller **161** and, in accordance with the information provided by sensor **169** about the state of tactile output generator **167**, haptic feedback controller **161** adjusts the waveforms output from haptic feedback controller **161** (e.g., waveforms sent to tactile output generator **167**, optionally via amplifier **163**).

FIG. **2** illustrates a portable multifunction device **100** having a touch screen (e.g., touch-sensitive display system **112**, FIG. **1**A) in accordance with some embodiments. The touch screen optionally displays one or more graphics within user interface (UI) **200**. In these embodiments, as well as others described below, a user is enabled to select one or more of the graphics by making a gesture on the graphics, for example, with one or more fingers **202** (not drawn to scale in the figure) or one or more styluses **203** (not drawn to scale in the figure). In some embodiments, selection of one or more graphics occurs when the user breaks contact with the one or more graphics. In some embodiments, the gesture optionally includes one or more taps, one or more swipes (from left to right, right to left, upward and/or downward) and/or a rolling of a finger (from right to left, left to right, upward and/or downward) that has made contact with device **100**. In some implementations or circumstances, inadvertent contact with a graphic does not select the graphic. For example, a swipe gesture that sweeps over an

application icon optionally does not select the corresponding application when the gesture corresponding to selection is a tap.

Device **100** optionally also includes one or more physical buttons, such as "home" or menu button **204**. As described previously, menu button **204** is, optionally, used to navigate to any application **136** in a set of applications that are, optionally executed on device **100**. Alternatively, in some embodiments, the menu button is implemented as a soft key in a GUI displayed on the touch-screen display.

In some embodiments, device **100** includes the touch-screen display, menu button **204** (sometimes called home button **204**), push button **206** for powering the device on/off and locking the device, volume adjustment button(s) **208**, Subscriber Identity Module (SIM) card slot **210**, head set jack **212**, and docking/charging external port **124**. Push button **206** is, optionally, used to turn the power on/off on the device by depressing the button and holding the button in the depressed state for a predefined time interval; to lock the device by depressing the button and releasing the button before the predefined time interval has elapsed; and/or to unlock the device or initiate an unlock process. In some embodiments, device **100** also accepts verbal input for activation or deactivation of some functions through microphone **113**. Device **100** also, optionally, includes one or more contact intensity sensors **165** for detecting intensities of contacts on touch-sensitive display system **112** and/or one or more tactile output generators **167** for generating tactile outputs for a user of device **100**.

FIG. **3** is a block diagram of an example multifunction device with a display and a touch-sensitive surface in accordance with some embodiments. Device **300** need not be portable. In some embodiments, device **300** is a laptop computer, a desktop computer, a tablet computer, a multimedia player device, a navigation device, an educational device (such as a child's learning toy), a gaming system, or a control device (e.g., a home or industrial controller). Device **300** typically includes one or more processing units (CPU's) **310**, one or more network or other communications interfaces **360**, memory **370**, and one or more communication buses **320** for interconnecting these components. Communication buses **320** optionally include circuitry (sometimes called a chipset) that interconnects and controls communications between system components. Device **300** includes input/output (I/O) interface **330** comprising display **340**, which is typically a touch-screen display. I/O interface **330** also optionally includes a keyboard and/or mouse (or other pointing device) **350** and touchpad **355**, tactile output generator **357** for generating tactile outputs on device **300** (e.g., similar to tactile output generator(s) **167** described above with reference to FIG. **1**A), sensors **359** (e.g., optical, acceleration, proximity, touch-sensitive, and/or contact intensity sensors similar to contact intensity sensor(s) **165** described above with reference to FIG. **1**A). Memory **370** includes high-speed random access memory, such as DRAM, SRAM, DDR RAM or other random access solid state memory devices; and optionally includes non-volatile memory, such as one or more magnetic disk storage devices, optical disk storage devices, flash memory devices, or other non-volatile solid state storage devices. Memory **370** optionally includes one or more storage devices remotely located from CPU(s) **310**. In some embodiments, memory **370** stores programs, modules, and data structures analogous to the programs, modules, and data structures stored in memory **102** of portable multifunction device **100** (FIG. **1**A), or a subset thereof. Furthermore, memory **370** optionally stores additional programs, modules, and data structures

not present in memory **102** of portable multifunction device **100**. For example, memory **370** of device **300** optionally stores drawing module **380**, presentation module **382**, word processing module **384**, website creation module **386**, disk authoring module **388**, and/or spreadsheet module **390**, while memory **102** of portable multifunction device **100** (FIG. **1**A) optionally does not store these modules.

Each of the above identified elements in FIG. **3** are, optionally, stored in one or more of the previously mentioned memory devices. Each of the above identified modules corresponds to a set of instructions for performing a function described above. The above identified modules or programs (i.e., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules are, optionally, combined or otherwise re-arranged in various embodiments. In some embodiments, memory **370** optionally stores a subset of the modules and data structures identified above. Furthermore, memory **370** optionally stores additional modules and data structures not described above.

Attention is now directed towards embodiments of user interfaces ("UI") that are, optionally, implemented on portable multifunction device **100**.

FIG. **4**A illustrates an example user interface for a menu of applications on portable multifunction device **100** in accordance with some embodiments. Similar user interfaces are, optionally, implemented on device **300**. In some embodiments, user interface **400** includes the following elements, or a subset or superset thereof:

- Signal strength indicator(s) for wireless communication(s), such as cellular and Wi-Fi signals;
- Time;
- a Bluetooth indicator;
- a Battery status indicator;
- Tray **408** with icons for frequently used applications, such as:
  - Icon **416** for telephone module **138**, labeled "Phone," which optionally includes an indicator **414** of the number of missed calls or voicemail messages;
  - Icon **418** for e-mail client module **140**, labeled "Mail," which optionally includes an indicator **410** of the number of unread e-mails;
  - Icon **420** for browser module **147**, labeled "Browser;" and
  - Icon **422** for video and music player module **152**, labeled "Music;" and
- Icons for other applications, such as:
  - Icon **424** for IM module **141**, labeled "Messages;"
  - Icon **426** for calendar module **148**, labeled "Calendar;"
  - Icon **428** for image management module **144**, labeled "Photos;"
  - Icon **430** for camera module **143**, labeled "Camera;"
  - Icon **432** for online video module **155**, labeled "Online Video;"
  - Icon **434** for stocks mini application **149-2**, labeled "Stocks;"
  - Icon **436** for map module **154**, labeled "Maps;"
  - Icon **438** for weather mini application **149-1**, labeled "Weather;"
  - Icon **440** for alarm clock mini application **149-4**, labeled "Clock;"
  - Icon **442** for workout support module **142**, labeled "Workout Support;"
  - Icon **444** for notes module **153**, labeled "Notes;" and
  - Icon **446** for a settings application or module, which provides access to settings for device **100** and its various applications **136**.

It should be noted that the icon labels illustrated in FIG. **4**A are merely examples. For example, other labels are, optionally, used for various application icons. In some embodiments, a label for a respective application icon includes a name of an application corresponding to the respective application icon. In some embodiments, a label for a particular application icon is distinct from a name of an application corresponding to the particular application icon.

FIG. **4**B illustrates an example user interface on a device (e.g., device **300**, FIG. **3**) with a touch-sensitive surface **451** (e.g., a tablet or touchpad **355**, FIG. **3**) that is separate from the display **450**. Although many of the examples that follow will be given with reference to inputs on touch screen display **112** (where the touch sensitive surface and the display are combined), in some embodiments, the device detects inputs on a touch-sensitive surface that is separate from the display, as shown in FIG. **4**B. In some embodiments, the touch-sensitive surface (e.g., **451** in FIG. **4**B) has a primary axis (e.g., **452** in FIG. **4**B) that corresponds to a primary axis (e.g., **453** in FIG. **4**B) on the display (e.g., **450**). In accordance with these embodiments, the device detects contacts (e.g., **460** and **462** in FIG. **4**B) with the touch-sensitive surface **451** at locations that correspond to respective locations on the display (e.g., in FIG. **4**B, **460** corresponds to **468** and **462** corresponds to **470**). In this way, user inputs (e.g., contacts **460** and **462**, and movements thereof) detected by the device on the touch-sensitive surface (e.g., **451** in FIG. **4**B) are used by the device to manipulate the user interface on the display (e.g., **450** in FIG. **4**B) of the multifunction device when the touch-sensitive surface is separate from the display. It should be understood that similar methods are, optionally, used for other user interfaces described herein.

Additionally, while the following examples are given primarily with reference to finger inputs (e.g., finger contacts, finger tap gestures, finger swipe gestures, etc.), it should be understood that, in some embodiments, one or more of the finger inputs are replaced with input from another input device (e.g., a mouse based input or a stylus input). For example, a swipe gesture is, optionally, replaced with a mouse click (e.g., instead of a contact) followed by movement of the cursor along the path of the swipe (e.g., instead of movement of the contact). As another example, a tap gesture is, optionally, replaced with a mouse click while the cursor is located over the location of the tap gesture (e.g., instead of detection of the contact followed by ceasing to detect the contact). Similarly, when multiple user inputs are simultaneously detected, it should be understood that multiple computer mice are, optionally, used simultaneously, or a mouse and finger contacts are, optionally, used simultaneously.

As used herein, the term “focus selector” refers to an input element that indicates a current part of a user interface with which a user is interacting. In some implementations that include a cursor or other location marker, the cursor acts as a “focus selector,” so that when an input (e.g., a press input) is detected on a touch-sensitive surface (e.g., touchpad **355** in FIG. **3** or touch-sensitive surface **451** in FIG. **4**B) while the cursor is over a particular user interface element (e.g., a button, window, slider or other user interface element), the particular user interface element is adjusted in accordance with the detected input. In some implementations that include a touch-screen display (e.g., touch-sensitive display system **112** in FIG. **1**A or the touch screen in FIG. **4**A) that enables direct interaction with user interface elements on the touch-screen display, a detected contact on the touch-screen acts as a “focus selector,” so that when an input (e.g., a press input by the contact) is detected on the touch-screen display at a location of a particular user interface element (e.g., a button, window, slider or other user interface element), the particular user interface element is adjusted in accordance with the detected input. In some implementations, focus is moved from one region of a user interface to another region of the user interface without corresponding movement of a cursor or movement of a contact on a touch-screen display (e.g., by using a tab key or arrow keys to move focus from one button to another button); in these implementations, the focus selector moves in accordance with movement of focus between different regions of the user interface. Without regard to the specific form taken by the focus selector, the focus selector is generally the user interface element (or contact on a touch-screen display) that is controlled by the user so as to communicate the user’s intended interaction with the user interface (e.g., by indicating, to the device, the element of the user interface with which the user is intending to interact). For example, the location of a focus selector (e.g., a cursor, a contact, or a selection box) over a respective button while a press input is detected on the touch-sensitive surface (e.g., a touchpad or touch screen) will indicate that the user is intending to activate the respective button (as opposed to other user interface elements shown on a display of the device).

As used in the specification and claims, the term “intensity” of a contact on a touch-sensitive surface refers to the force or pressure (force per unit area) of a contact (e.g., a finger contact or a stylus contact) on the touch-sensitive surface, or to a substitute (proxy) for the force or pressure of a contact on the touch-sensitive surface. The intensity of a contact has a range of values that includes at least four distinct values and more typically includes hundreds of distinct values (e.g., at least 256). Intensity of a contact is, optionally, determined (or measured) using various approaches and various sensors or combinations of sensors. For example, one or more force sensors underneath or adjacent to the touch-sensitive surface are, optionally, used to measure force at various points on the touch-sensitive surface. In some implementations, force measurements from multiple force sensors are combined (e.g., a weighted average or a sum) to determine an estimated force of a contact. Similarly, a pressure-sensitive tip of a stylus is, optionally, used to determine a pressure of the stylus on the touch-sensitive surface. Alternatively, the size of the contact area detected on the touch-sensitive surface and/or changes thereto, the capacitance of the touch-sensitive surface proximate to the contact and/or changes thereto, and/or the resistance of the touch-sensitive surface proximate to the contact and/or changes thereto are, optionally, used as a substitute for the force or pressure of the contact on the touch-sensitive surface. In some implementations, the substitute measurements for contact force or pressure are used directly to determine whether an intensity threshold has been exceeded (e.g., the intensity threshold is described in units corresponding to the substitute measurements). In some implementations, the substitute measurements for contact force or pressure are converted to an estimated force or pressure and the estimated force or pressure is used to determine whether an intensity threshold has been exceeded (e.g., the intensity threshold is a pressure threshold measured in units of pressure). Using the intensity of a contact as an attribute of a user input allows for user access to additional device functionality that may otherwise not be readily accessible by the user on a reduced-size device with limited real estate for displaying affordances (e.g., on a touch-sensitive display) and/or receiving user input (e.g., via

a touch-sensitive display, a touch-sensitive surface, or a physical/mechanical control such as a knob or a button).

In some embodiments, contact/motion module **130** uses a set of one or more intensity thresholds to determine whether an operation has been performed by a user (e.g., to determine whether a user has "clicked" on an icon). In some embodiments, at least a subset of the intensity thresholds are determined in accordance with software parameters (e.g., the intensity thresholds are not determined by the activation thresholds of particular physical actuators and can be adjusted without changing the physical hardware of device **100**). For example, a mouse "click" threshold of a trackpad or touch-screen display can be set to any of a large range of predefined thresholds values without changing the trackpad or touch-screen display hardware. Additionally, in some implementations a user of the device is provided with software settings for adjusting one or more of the set of intensity thresholds (e.g., by adjusting individual intensity thresholds and/or by adjusting a plurality of intensity thresholds at once with a system-level click "intensity" parameter).

As used in the specification and claims, the term "characteristic intensity" of a contact refers to a characteristic of the contact based on one or more intensities of the contact. In some embodiments, the characteristic intensity is based on multiple intensity samples. The characteristic intensity is, optionally, based on a predefined number of intensity samples, or a set of intensity samples collected during a predetermined time period (e.g., 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 seconds) relative to a predefined event (e.g., after detecting the contact, prior to detecting liftoff of the contact, before or after detecting a start of movement of the contact, prior to detecting an end of the contact, before or after detecting an increase in intensity of the contact, and/or before or after detecting a decrease in intensity of the contact). A characteristic intensity of a contact is, optionally based on one or more of: a maximum value of the intensities of the contact, a mean value of the intensities of the contact, an average value of the intensities of the contact, a top 10 percentile value of the intensities of the contact, a value at the half maximum of the intensities of the contact, a value at the 90 percent maximum of the intensities of the contact, a value produced by low-pass filtering the intensity of the contact over a predefined period or starting at a predefined time, or the like. In some embodiments, the duration of the contact is used in determining the characteristic intensity (e.g., when the characteristic intensity is an average of the intensity of the contact over time). In some embodiments, the characteristic intensity is compared to a set of one or more intensity thresholds to determine whether an operation has been performed by a user. For example, the set of one or more intensity thresholds may include a first intensity threshold and a second intensity threshold. In this example, a contact with a characteristic intensity that does not exceed the first intensity threshold results in a first operation, a contact with a characteristic intensity that exceeds the first intensity threshold and does not exceed the second intensity threshold results in a second operation, and a contact with a characteristic intensity that exceeds the second intensity threshold results in a third operation. In some embodiments, a comparison between the characteristic intensity and one or more intensity thresholds is used to determine whether or not to perform one or more operations (e.g., whether to perform a respective option or forgo performing the respective operation) rather than being used to determine whether to perform a first operation or a second operation.

In some embodiments, a portion of a gesture is identified for purposes of determining a characteristic intensity. For example, a touch-sensitive surface may receive a continuous swipe contact transitioning from a start location and reaching an end location (e.g., a drag gesture), at which point the intensity of the contact increases. In this example, the characteristic intensity of the contact at the end location may be based on only a portion of the continuous swipe contact, and not the entire swipe contact (e.g., only the portion of the swipe contact at the end location). In some embodiments, a smoothing algorithm may be applied to the intensities of the swipe contact prior to determining the characteristic intensity of the contact. For example, the smoothing algorithm optionally includes one or more of: an unweighted sliding-average smoothing algorithm, a triangular smoothing algorithm, a median filter smoothing algorithm, and/or an exponential smoothing algorithm. In some circumstances, these smoothing algorithms eliminate narrow spikes or dips in the intensities of the swipe contact for purposes of determining a characteristic intensity.

The user interface figures described herein optionally include various intensity diagrams that show the current intensity of the contact on the touch-sensitive surface relative to one or more intensity thresholds (e.g., a contact detection intensity threshold IT_0, a light press intensity threshold IT_L, a deep press intensity threshold IT_D (e.g., that is at least initially higher than IT_L), and/or one or more other intensity thresholds (e.g., an intensity threshold IT_H that is lower than IT_L)). This intensity diagram is typically not part of the displayed user interface, but is provided to aid in the interpretation of the figures. In some embodiments, the light press intensity threshold corresponds to an intensity at which the device will perform operations typically associated with clicking a button of a physical mouse or a trackpad. In some embodiments, the deep press intensity threshold corresponds to an intensity at which the device will perform operations that are different from operations typically associated with clicking a button of a physical mouse or a trackpad. In some embodiments, when a contact is detected with a characteristic intensity below the light press intensity threshold (e.g., and above a nominal contact-detection intensity threshold IT_0 below which the contact is no longer detected), the device will move a focus selector in accordance with movement of the contact on the touch-sensitive surface without performing an operation associated with the light press intensity threshold or the deep press intensity threshold. Generally, unless otherwise stated, these intensity thresholds are consistent between different sets of user interface figures.

In some embodiments, the response of the device to inputs detected by the device depends on criteria based on the contact intensity during the input. For example, for some "light press" inputs, the intensity of a contact exceeding a first intensity threshold during the input triggers a first response. In some embodiments, the response of the device to inputs detected by the device depends on criteria that include both the contact intensity during the input and time-based criteria. For example, for some "deep press" inputs, the intensity of a contact exceeding a second intensity threshold during the input, greater than the first intensity threshold for a light press, triggers a second response only if a delay time has elapsed between meeting the first intensity threshold and meeting the second intensity threshold. This delay time is typically less than 200 ms (milliseconds) in duration (e.g., 40, 100, or 120 ms, depending on the magnitude of the second intensity threshold, with the delay time increasing as the second intensity threshold increases). This delay time helps to avoid accidental recognition of deep press inputs. As another example, for some "deep press" inputs, there is a reduced-sensitivity time period that occurs

after the time at which the first intensity threshold is met. During the reduced-sensitivity time period, the second intensity threshold is increased. This temporary increase in the second intensity threshold also helps to avoid accidental deep press inputs. For other deep press inputs, the response to detection of a deep press input does not depend on time-based criteria.

In some embodiments, one or more of the input intensity thresholds and/or the corresponding outputs vary based on one or more factors, such as user settings, contact motion, input timing, application running, rate at which the intensity is applied, number of concurrent inputs, user history, environmental factors (e.g., ambient noise), focus selector position, and the like. Example factors are described in U.S. patent application Ser. Nos. 14/399,606 and 14/624,296, which are incorporated by reference herein in their entireties.

For example, FIG. **4**C illustrates a dynamic intensity threshold **480** that changes over time based in part on the intensity of touch input **476** over time. Dynamic intensity threshold **480** is a sum of two components, first component **474** that decays over time after a predefined delay time p**1** from when touch input **476** is initially detected, and second component **478** that trails the intensity of touch input **476** over time. The initial high intensity threshold of first component **474** reduces accidental triggering of a "deep press" response, while still allowing an immediate "deep press" response if touch input **476** provides sufficient intensity. Second component **478** reduces unintentional triggering of a "deep press" response by gradual intensity fluctuations of in a touch input. In some embodiments, when touch input **476** satisfies dynamic intensity threshold **480** (e.g., at point **481** in FIG. **4**C), the "deep press" response is triggered.

FIG. **4**D illustrates another dynamic intensity threshold **486** (e.g., intensity threshold I_D). FIG. **4**D also illustrates two other intensity thresholds: a first intensity threshold I_H and a second intensity threshold I_L. In FIG. **4**D, although touch input **484** satisfies the first intensity threshold I_H and the second intensity threshold I_L prior to time p**2**, no response is provided until delay time p**2** has elapsed at time **482**. Also in FIG. **4**D, dynamic intensity threshold **486** decays over time, with the decay starting at time **488** after a predefined delay time p**1** has elapsed from time **482** (when the response associated with the second intensity threshold I_L was triggered). This type of dynamic intensity threshold reduces accidental triggering of a response associated with the dynamic intensity threshold I_D immediately after, or concurrently with, triggering a response associated with a lower intensity threshold, such as the first intensity threshold I_H or the second intensity threshold I_L.

FIG. **4**E illustrate yet another dynamic intensity threshold **492** (e.g., intensity threshold I_D). In FIG. **4**E, a response associated with the intensity threshold I_L is triggered after the delay time p**2** has elapsed from when touch input **490** is initially detected. Concurrently, dynamic intensity threshold **492** decays after the predefined delay time p**1** has elapsed from when touch input **490** is initially detected. So a decrease in intensity of touch input **490** after triggering the response associated with the intensity threshold I_L, followed by an increase in the intensity of touch input **490**, without releasing touch input **490**, can trigger a response associated with the intensity threshold I_D (e.g., at time **494**) even when the intensity of touch input **490** is below another intensity threshold, for example, the intensity threshold I_L.

An increase of characteristic intensity of the contact from an intensity below the light press intensity threshold IT_L to an intensity between the light press intensity threshold IT_L and the deep press intensity threshold ITS is sometimes referred to as a "light press" input. An increase of characteristic intensity of the contact from an intensity below the deep press intensity threshold ITS to an intensity above the deep press intensity threshold ITS is sometimes referred to as a "deep press" input. An increase of characteristic intensity of the contact from an intensity below the contact-detection intensity threshold IT_0 to an intensity between the contact-detection intensity threshold IT_0 and the light press intensity threshold IT_L is sometimes referred to as detecting the contact on the touch-surface. A decrease of characteristic intensity of the contact from an intensity above the contact-detection intensity threshold IT_0 to an intensity below the contact-detection intensity threshold IT_0 is sometimes referred to as detecting liftoff of the contact from the touch-surface. In some embodiments IT_0 is zero. In some embodiments, IT_0 is greater than zero. In some illustrations a shaded circle or oval is used to represent intensity of a contact on the touch-sensitive surface. In some illustrations, a circle or oval without shading is used represent a respective contact on the touch-sensitive surface without specifying the intensity of the respective contact.

In some embodiments, described herein, one or more operations are performed in response to detecting a gesture that includes a respective press input or in response to detecting the respective press input performed with a respective contact (or a plurality of contacts), where the respective press input is detected based at least in part on detecting an increase in intensity of the contact (or plurality of contacts) above a press-input intensity threshold. In some embodiments, the respective operation is performed in response to detecting the increase in intensity of the respective contact above the press-input intensity threshold (e.g., the respective operation is performed on a "down stroke" of the respective press input). In some embodiments, the press input includes an increase in intensity of the respective contact above the press-input intensity threshold and a subsequent decrease in intensity of the contact below the press-input intensity threshold, and the respective operation is performed in response to detecting the subsequent decrease in intensity of the respective contact below the press-input threshold (e.g., the respective operation is performed on an "up stroke" of the respective press input).

In some embodiments, the device employs intensity hysteresis to avoid accidental inputs sometimes termed "jitter," where the device defines or selects a hysteresis intensity threshold with a predefined relationship to the press-input intensity threshold (e.g., the hysteresis intensity threshold is X intensity units lower than the press-input intensity threshold or the hysteresis intensity threshold is 75%, 90%, or some reasonable proportion of the press-input intensity threshold). Thus, in some embodiments, the press input includes an increase in intensity of the respective contact above the press-input intensity threshold and a subsequent decrease in intensity of the contact below the hysteresis intensity threshold that corresponds to the press-input intensity threshold, and the respective operation is performed in response to detecting the subsequent decrease in intensity of the respective contact below the hysteresis intensity threshold (e.g., the respective operation is performed on an "up stroke" of the respective press input). Similarly, in some embodiments, the press input is detected only when the device detects an increase in intensity of the contact from an intensity at or below the hysteresis intensity threshold to an intensity at or above the press-input intensity threshold and, optionally, a subsequent decrease in intensity of the contact to an intensity at or below the hysteresis intensity, and the

respective operation is performed in response to detecting the press input (e.g., the increase in intensity of the contact or the decrease in intensity of the contact, depending on the circumstances).

For ease of explanation, the description of operations performed in response to a press input associated with a press-input intensity threshold or in response to a gesture including the press input are, optionally, triggered in response to detecting: an increase in intensity of a contact above the press-input intensity threshold, an increase in intensity of a contact from an intensity below the hysteresis intensity threshold to an intensity above the press-input intensity threshold, a decrease in intensity of the contact below the press-input intensity threshold, or a decrease in intensity of the contact below the hysteresis intensity threshold corresponding to the press-input intensity threshold. Additionally, in examples where an operation is described as being performed in response to detecting a decrease in intensity of a contact below the press-input intensity threshold, the operation is, optionally, performed in response to detecting a decrease in intensity of the contact below a hysteresis intensity threshold corresponding to, and lower than, the press-input intensity threshold. As described above, in some embodiments, the triggering of these responses also depends on time-based criteria being met (e.g., a delay time has elapsed between a first intensity threshold being met and a second intensity threshold being met).

User Interfaces and Associated Processes

Attention is now directed towards embodiments of user interfaces ("UI") and associated processes that may be implemented on an electronic device, such as portable multifunction device **100** or device **300**, with a display, a touch-sensitive surface, (optionally) one or more tactile output generators for generating tactile outputs, and (optionally) one or more sensors to detect intensities of contacts with the touch-sensitive surface.

FIGS. **5**A-**5**AZ illustrate example user interfaces for clearing sets of notifications in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **6**A-**6**G. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. In such embodiments, the focus selector is, optionally: a respective finger or stylus contact, a representative point corresponding to a finger or stylus contact (e.g., a centroid of a respective contact or a point associated with a respective contact), or a centroid of two or more contacts detected on the touch-sensitive display system **112**. However, analogous operations are, optionally, performed on a device with a display **450** and a separate touch-sensitive surface **451** in response to detecting the contacts on the touch-sensitive surface **451** while displaying the user interfaces shown in the figures on the display **450**, along with a focus selector.

FIGS. **5A1** to **5A4** illustrate activation of a display (e.g., touch-sensitive display **112**) in response to changing an orientation of device **100**. When the display has been activated, notifications that were received while the device was in a screen-off state were received. These notifications are displayed when the device transitions to a screen-on state. In some embodiments, the device uses one or more sensors (e.g., accelerometer, gyro, audio sensor, heat sensor, and/or light sensor) to determine whether an orientation of the device has changed. For example, the device determines whether the device has been rotated by more than a threshold angle (e.g., rotated along an axis of the device, such as tilted from a position in which the device is substantially horizontal to a position in which the device is substantially vertical). In FIG. **5A1**, the device is in a screen-off state while it is held flat in a user's hand **502**, such that the device display is substantially horizontal. In FIG. **5A2**, the device is tilted such that the display is more vertical than in FIG. **5A1**. Because a tilt angle of the device has not increased above a threshold tilt angle in FIG. **5A2**, the display is not activated. In FIG. **5A3**, the device is tilted such that the display is more vertical than in FIG. **5A2**. Because a tilt angle of the device has increased above a threshold tilt angle in FIG. **5A3**, the display has transitioned from a screen-off state to a screen-on state and wake screen user interface **504** is displayed by the display **112**. In FIG. **5A4**, the display **112** is substantially vertical.

In some embodiments, wake screen user interface **504** is a user interface that is displayed when the device transitions from a screen-off state to a screen-on state (e.g., while the device **100** is in a locked state) and wake screen user interface **504** is available to be redisplayed (e.g., to allow a user to view notifications, access a mini application user interface and/or access a control center user interface, as described further below) after the device is unlocked. In some embodiments, when wake screen user interface **504** is accessed after the device is unlocked, wake screen user interface **504** is referred to as a cover sheet user interface. The terms "wake screen user interface" and "cover sheet user interface" are used interchangeably herein to refer to wake screen user interface **504**.

FIG. **5**B illustrates a wake screen user interface **504**, in accordance with some embodiments. Wake screen user interface **504** displays missed notifications **506**, **508**, **510**, and **512** that were received and/or generated by device **100** (e.g., while device **100** was in a screen-off state).

In some embodiments, the missed notifications that are displayed on the wake screen user interface **504** are cleared individually in response to user interaction with a notification (e.g., when a user accesses an application that corresponds to a notification, as illustrated at FIGS. **5**L-**5**M, or when a user provides input to delete a notification, as illustrated at FIGS. **5**Y-**5**AC). In some embodiments, a set of all missed notifications are collectively cleared when notification clearance criteria are satisfied, e.g., when input is received at a time that is (1) after a respective notification of the one or more notifications has been cleared through direct user interaction with the respective notification or an application that corresponds to the respective notification and (2) after the device has transitioned from the screen-on state to the screen-off state at least once since the last direct user interaction that dismissed a respective notification.

In FIGS. **5**B-**5**D, the device transitions from a screen-on state to a screen-off state. Since this transition has not occurred after a user interaction to dismiss a notification, the missed notifications remain displayed, as shown in FIG. **5**D.

After device **100** transitions from a screen-off state, as shown in FIG. **5**A, to a screen-on state, as shown in FIG. **5**B, the device **100** transitions from the screen-on state back to a screen-off state, as shown in FIG. **5**C. In some embodiments, a transition from a screen-on state to a screen-off state (and/or from a screen-off state to a screen-on state) occurs in response to an input detected at a control (e.g., a push button **206**) of device **100**. In some embodiments, a transition from a screen-on state to a screen-off state occurs when a time during which no input has been detected by the device increases beyond a threshold duration.

In FIG. **5**D, the device has transitioned from the screen-off state shown in FIG. **5**C back to a screen-on state. Notifications **506**, **508**, **510**, and **512** continue to be displayed after the transition from a screen-on state (as shown in FIG. **5**B) to a screen-off state (as shown in FIG. **5**C) and back to a screen-on state (as shown in FIG. **5**D).

In FIGS. **5**E-**5**K, a set of missed notifications remains available on wake screen user interface **504** after user input is provided to unlock the device.

FIG. **5**E illustrates an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated at a lower edge of touch screen **112**, as indicated by focus selector **514**. In response to the input, in accordance with a determination that the device is locked, an authentication user interface **518** is displayed, as shown in FIG. **5**F.

In FIG. **5**G, an authentication input (e.g., a tap input) by a contact on touch screen **112** is detected at a location within authentication user interface **518**, as indicated by focus selector **520**. In response to the authentication input, the device is unlocked and home screen user interface **522** (e.g., a user interface for a menu of applications as described with regard to FIG. **4**A) is displayed, as shown in FIG. **5**H.

FIGS. **5**I-**5**J illustrate an input (e.g., a downward swipe) that is initiated by a contact at an upper edge of touch screen **112**, as indicated by focus selector **524**. In response to the input, wake screen user interface **504** slides down from the upper edge of display **112**, as shown in FIGS. **5**I-**5**K. As indicated in FIG. **5**K, notifications **506**, **508**, **510**, and **512** continue to be displayed on the wake screen user interface **504** when wake screen user interface **504** is revealed after the device is unlocked and home screen user interface **522** is displayed.

FIGS. **5**L-**5**M illustrate a user interaction with notification **510** that causes the notification to be dismissed (as shown in FIG. **5**P), while notifications **506**, **508**, and **512** remain displayed on wake screen user interface **504** (e.g., because no transition from the screen-on state to the screen-off state has occurred since the user interaction to dismiss notification **510**).

In FIG. **5**L, an input (e.g., a tap input) by a contact on touch screen **112** is detected at a location that corresponds to notification **510**, as indicated by focus selector **528**. In response to the input, wake screen user interface **504** ceases to be displayed and an application user interface (e.g., messages application user interface **530**) that corresponds to the notification **510** is displayed, as shown in FIG. **5**M.

FIGS. **5**N-**5**O illustrate an input (e.g., a downward swipe) that is initiated by a contact on touch screen **112** at an upper edge of touch screen **112**, as indicated by focus selector **532**. In response to the input, wake screen user interface **504** slides down from the upper edge of display **112**, as shown in FIGS. **5**N-**5**P. As indicated in FIG. **5**P, as a result of the interaction with notification **510** (e.g., the tap input on notification **510** that caused the messages application user interface **530** to be displayed) notification **510** is no longer displayed on wake screen user interface **504**. In FIG. **5**P, notifications **506**, **508**, and **512** continue to be displayed on the wake screen user interface **504**.

In FIGS. **5**Q-**5**X, after navigation to a first application user interface and from the first application user interface to a second application user interface, notifications **506**, **508**, and **512** continue to be displayed (as shown in FIG. **5**X).

FIG. **5**Q illustrates an input (e.g., a upward swipe) that is initiated by a contact at a location near the lower edge of touch screen **112**, as indicated by focus selector **534**. In response to the input, wake screen user interface **504** slides up from the lower edge of display **112** to redisplay the underlying messages application user interface **530** (that was previously covered by wake screen user interface **504**), as shown in FIGS. **5**Q-**5**R.

FIG. **5**S illustrates an input by a contact on touch screen **112** that is initiated by a contact at a location near the lower edge of touch screen **112**, as indicated by focus selector **536**. In response to the input, during which the focus selector moves along a path indicated by arrow **538**, messages application user interface **530** moves along the path indicated by arrow **538** to reveal web browser application user interface **540**, as shown in FIGS. **5**S-**5**U.

FIGS. **5**V-**5**W illustrate an input (e.g., a downward swipe) that is initiated by a contact at a location near the upper edge of touch screen **112**, as indicated by focus selector **542**. In response to the input, wake screen user interface **504** slides down from the lower edge of display **112**, as shown in FIGS. **5**V-**5**X.

FIGS. **5**Y-**5**AC illustrate a user interaction with notification **506** that causes notification **506** to be dismissed (as shown in FIG. **5**AC), while notifications **508** and **512** remain displayed on wake screen user interface **504** (e.g., because no transition from the screen-on state to the screen-off state has occurred since the user interaction to dismiss notification **510** and no transition from the screen-on state to the screen-off state has occurred since the user interaction to dismiss notification **506**).

FIGS. **5**AD-**5**AO illustrate user input to access a music application user interface **560** and to initiate an active playback mode of the music application. While the music application is in an active playback mode, a media banner **568** is displayed on wake screen user interface **504**, as shown in FIG. **5**AO. FIGS. **5**AP-**5**AU illustrate input to stop media playback. When music application is not in an active playback mode, media banner **568** is no longer displayed on wake screen user interface **504**, as shown in FIG. **5**AU.

FIGS. **5**Y-**5**Z illustrate an input (e.g., a horizontal drag input) by a contact on touch screen **112** at a location that corresponds to notification **506**, as indicated by focus selector **544**. In response to the input, deletion affordance **546** is revealed at a location that is adjacent to notification **506**, as shown in FIG. **5**Z. In FIG. **5**AA, the contact indicated by focus selector **544** has lifted off of touch screen **112**.

In FIG. **5**AB, an input (e.g., a tap input) is detected at a location that corresponds to deletion affordance **546**, as indicated by focus selector **548**. In response to the input, notification **506** ceases to be displayed on wake screen user interface **504**, as shown in FIG. **5**AC. In FIG. **5**AC, notifications **508** and **512** continue to be displayed on the wake screen user interface **504**.

FIGS. **5**AD-**5**AE illustrate an input (e.g., an upward swipe) that is initiated by a contact at a location near the upper edge of touch screen **112**, as indicated by focus selector **550**. In response to the input, wake screen user interface **504** slides up from the lower edge of display **112** to redisplay the underlying web browser application user interface **540** (that was previously covered by wake screen user interface **504**), as shown in FIGS. **5**AD-**5**AF.

FIG. **5**AG illustrates an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated by a contact at location that corresponds to home affordance **552**, as indicated by focus selector **554**. In response to the input, display of web browser application user interface **540** is replaced by display of home screen user interface **522**, as shown in FIGS. **5**AG-**5**AH.

In FIG. **5**AI, an input (e.g., a tap input) is detected at a location that corresponds to affordance **556** for displaying a music application interface, as indicated by focus selector

558. In response to the input, a music application user interface **552** is displayed, as shown in FIG. **5**AJ.

In FIG. **5**AK, an input (e.g., a tap input) is detected at a location that corresponds to media playback control affordance **562**, as indicated by focus selector **564**. In response to the input, the music application transitions to an active playback mode (e.g., music playback is initiated) as shown in FIG. **5**AL (e.g., as indicated by the changed state of media playback control affordance **562**).

FIGS. **5**AM-**5**AN illustrate an input (e.g., a downward swipe) that is initiated by a contact at a location near the upper edge of touch screen **112**, as indicated by focus selector **566**. In response to the input, wake screen user interface **504** slides down from the upper edge of display **112**, as shown in FIGS. **5**AM-**5**AO.

FIG. AO shows a wake screen user interface **504** that displays a media banner **568** that corresponds to the ongoing music playback initiated from the music application. As indicated in FIG. **5**AP, media banner **568** includes media track information **570** and a banner playback control affordance **572**.

In FIG. AP, an input (e.g., a tap input) is detected at a location that corresponds to banner playback control affordance **572**, as indicated by focus selector **574**. In response to the input, music playback is paused as shown in FIG. **5**AQ (e.g., as indicated by the changed state of banner playback control affordance **572**).

FIG. **5**AR illustrates an input (e.g., a upward swipe) that is initiated by a contact near the lower edge of touch screen **112**, as indicated by focus selector **576**. In response to the input, wake screen user interface **504** slides up from the lower edge of display **112** to redisplay the underlying music user interface **522** (that was previously covered by wake screen user interface **504**), as shown in FIGS. **5**AR-**5**AS.

FIG. **5**AT illustrates an input (e.g., a downward swipe) by a contact on touch screen **112**, as indicated by focus selector **578**. In response to the input, wake screen user interface **504** slides down from the upper edge of display **112**, as shown in FIGS. **5**AT-**5**AU.

In FIG. **5**AU, media banner **568** is no longer displayed on wake screen user interface **504** (e.g., because the input to display wake screen user interface **504** was received while the music application was not in an active media playback mode).

FIGS. **5**AV-**5**AW illustrate a transition from the screen-on state to the screen-off state that occurs after the user interaction to dismiss notification **510** (e.g., as described with regard to FIGS. **5**L-**5**P) and after the user interaction to dismiss notification **606** (as described with regard to FIGS. **5**Y-**5**AC). As shown in FIG. **5**AW, because notification clearance criteria are satisfied (e.g., input (to transition the device from the screen-off state to the screen-on state) is received at a time that is (1) after a respective notification of the one or more notifications has been cleared through direct user interaction with the respective notification or an application that corresponds to the respective notification and (2) after the device has transitioned from the screen-on state to the screen-off state at least once since the last direct user interaction that dismissed a respective notification), all notifications have been cleared from wake screen **504**.

In FIG. **5**AV, device **100** has transitioned from the screen-on state, as shown in FIG. **5**AU, to a screen-off state.

After the screen has transitioned from a screen-off state, as shown in FIG. **5**AV, back to a screen-on state, as shown in FIG. AW (and after the user has interacted with at least one notification, e.g., as described with regard to FIGS. **5**L-**5**P and/or as described with regard to FIGS. **5**Y-**5**AC), wake screen user interface **504** is displayed with no notifications.

FIGS. **5**AW-**5**AZ illustrate a “rubber band” effect that occurs when an input by a contact with touch screen **112** (as indicated by focus selector **580**) drags a time/date indicator **582** downward, and then the time/date indicator moves back to its original position in response to lift off of the contact from the touch sensitive surface. As focus selector **580** moves across touch screen **112** along a path indicated by arrow **584**, time/date indicator **582** moves in accordance with the movement of the focus selector **580**, as shown in FIGS. **5**AW-**5**AX. When focus selector **580** lifts off of touch screen **112**, the time/date indicator **582** returns to its original position, as shown in FIGS. **5**AY-**5**AZ.

FIGS. **5**BA-**5**CX illustrate example user interfaces for displaying notification history, in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **7**A-**7**E. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. In such embodiments, the focus selector is, optionally: a respective finger or stylus contact, a representative point corresponding to a finger or stylus contact (e.g., a centroid of a respective contact or a point associated with a respective contact), or a centroid of two or more contacts detected on the touch-sensitive display system **112**. However, analogous operations are, optionally, performed on a device with a display **450** and a separate touch-sensitive surface **451** in response to detecting the contacts on the touch-sensitive surface **451** while displaying the user interfaces shown in the figures on the display **450**, along with a focus selector.

FIG. **5**BA displays wake screen user interface **504** (e.g., in response to an event that triggered a transition from a screen-off state to a screen-on state). Wake screen user interface **504** displays missed notifications **586**, **588**, **590**, and **592**.

FIGS. **5**BB-**5**BE illustrate a “rubber band” effect that occurs when an input by a contact with touch screen **112** (as indicated by focus selector **594**) drags missed notifications **586**, **588**, **590**, and **592** and time/date indicator **582** downward, and then the missed notifications **586**, **588**, **590**, and **592** and time/date indicator **582** move back to their original positions in response to lift off of the contact from the touch sensitive surface. As focus selector **594** moves across touch screen **112** along a path indicated by arrow **596**, missed notifications **586**, **588**, **590**, and **592** and time/date indicator **582** move in accordance with the movement of the focus selector **594**, as shown in FIGS. **5**BB-**5**BC. When focus selector **594** lifts off of touch screen **112**, notifications **586**, **588**, **590**, and **592** and time/date indicator **582** return to their original positions, as shown in FIGS. **5**BD-**5**BE.

FIGS. **5**BF-**5**BG illustrate an input (e.g., an upward swipe) that causes missed notifications to scroll upwards, but that does not meet criteria for displaying previously received notifications. In FIG. **5**BF, an input is initiated by a contact with touch screen **112**, as indicated by focus selector **598**, within a region on wake screen interface **504** (e.g., a region delineated by dotted line **5100**) in which notifications **586**-**592** are displayed. In response to the input, missed notifications **586**-**592** move upward, as shown in FIGS. **5**BF-**5**BG, revealing an additional missed notification **5102** and a previously received notification indicator **5104**, as shown in FIG. **5**BH.

FIGS. **5**BI-**5**BN illustrate an input that meets criteria for displaying previously received notifications. In FIG. **5**BI, an input (e.g., an upward swipe) is initiated by a contact with touch screen **112** (e.g., at a location that corresponds to previously received notification indicator **5102**), as indicated by focus selector **5106**. In response to the input, missed notifications **586-592** move upward, as shown in FIGS. **5**BJ-**5**BP. As shown in FIG. **5**BK, when movement of the focus selector **5106** across touch screen **112** has increased above a threshold distance (as indicated by **5108**), previously received notification **506** is displayed, and the device generates a tactile output (as indicated at **5112**). After the focus selector **5106** moves beyond the threshold distance, additional previously received notifications **508** and **510** are displayed, and the previously received notifications **506**, **508**, and **510** move at a faster rate than the rate of movement of focus selector **5106** and missed notifications **590**, **592** and **5102** (e.g., to provide a visual effect of the previously received notifications **506**, **508**, and **510** "rushing to catch up" with the missed notifications **590**, **592** and **5102**), as shown in FIGS. **5**BK-**5**BM. In FIGS. **5**BM-**5**BN, focus selector **5106** continues to move upward across touch screen **112**, and previously received notification **512** is revealed. In FIGS. **5**BO-**5**BP, after the contact indicated by focus selector **5106** has lifted off from touch screen **112**, previously received notifications **506**, **508**, **510**, and **512** continue to move upward.

FIGS. **5**BQ-**5**BR illustrate an input that displays additional previously received notifications. In FIG. **5**BQ, an input (e.g., an upward swipe) is initiated by a contact with touch screen **112**, as indicated by focus selector **5120**, within a region on wake screen interface **504** in which previously received notifications **506-512** are displayed. In response to the input, previously received notifications **506-512** move upward, as shown in FIGS. **5**BQ-**5**BR. In FIG. **5**BR, a second previously received notification indicator **5122** (e.g., for notifications received on the previous day) and a previously received notification **5124** (e.g., received on the previous day) are displayed on wake screen user interface **504**.

FIGS. **5**BS-**5**BT illustrate an input to redisplay missed notifications. In FIG. **5**BS, an input (e.g., a downward swipe) is initiated by a contact with touch screen **112**, as indicated by focus selector **5126**, within a region on wake screen interface **504** in which previously received notifications **506-512** and **5124** are displayed. In response to the input, previously received notifications **506-512** and **5124** scroll downwards and missed notifications **590**, **592**, and **5102** are redisplayed on wake screen user interface **504**, as shown in FIGS. **5**BS-**5**BU.

FIGS. **5**BV-**5**BZ illustrate a user interaction with notification **592** that causes the notification to be dismissed (as shown in FIG. **5**BZ), while missed notifications other than **592** and previously received notifications remain displayed on wake screen user interface **504** (e.g., because no transition from the screen-on state to the screen-off state has occurred since the user interaction to dismiss notification **592**).

FIGS. **5**BV-**5**BW illustrate an input (e.g., a horizontal drag input) by a contact on touch screen **112** at a location that corresponds to notification **592**, as indicated by focus selector **5128**. In response to the input, deletion affordance **5130** is revealed at a location that is adjacent to notification **592**, as shown in FIG. **5**BW. In FIG. **5**BX, the contact indicated by focus selector **5130** has lifted off of touch screen **112**.

In FIG. **5**BY, an input (e.g., a tap input) is detected at a location that corresponds to deletion affordance **5130**, as indicated by focus selector **5132**. In response to the input, notification **592** ceases to be displayed on wake screen user interface **504**, as shown in FIG. **5**BZ.

FIG. **5**CA illustrates an input that meets criteria for dismissing previously dismissed notifications. In response to the input, only missed notifications remain displayed on wake screen **504**, as shown in FIG. **5**CB.

FIGS. **5**CA-**5**CB illustrate an input (e.g., a downward swipe) that is initiated by a contact with touch screen **112**, as indicated by focus selector **5136**, within a region on wake screen interface **504** in which missed notifications (e.g., **592** and **5102**) and/or previously received notifications (e.g., **506-510**) are displayed. In response to the input, previously received notifications **506-510** scroll downwards and missed notifications **586**, **588**, **592**, and **5102** are redisplayed on wake screen user interface **504**, as shown in FIG. **5**CA-**5**CB.

FIGS. **5**CC-**5**CQ illustrate input for accessing a control center user interface **5138**, a mini application user interface **5140**, and a user interface underlying wake screen user interface (e.g., home screen user interface **522**) from wake screen user interface **504**.

FIGS. **5**CC-**5**CD illustrate an input (e.g., a leftward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5136**. In response to the input, wake screen user interface **504** slides to the left and control center user interface **5138** is revealed, as shown in FIG. **5**CC-**5**CE.

FIGS. **5**CF-**5**CG illustrate an input (e.g., a rightward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5142**. In response to the input, control center user interface **5138** slides to the right and wake screen user interface **504** is revealed, as shown in FIG. **5**CF-**5**CH.

FIGS. **5**CI-**5**CJ illustrate an input (e.g., a rightward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5144**. In response to the input, wake screen user interface **504** slides to the right and mini application user interface **5140** is revealed, as shown in FIG. **5**CI-**5**CK.

FIGS. **5**CL-**5**CM illustrate an input (e.g., a leftward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5146**. In response to the input, mini application user interface **5140** slides to the left and wake screen user interface **504** is revealed, as shown in FIG. **5**CL-**5**CN.

FIG. **5**CO illustrates an input by a contact on touch screen **112** that is initiated at a lower edge of touch screen **112**, as indicated by focus selector **5146**. In response to the input, display of wake screen user interface **504** is replaced by display of home screen user interface **522**, as shown in FIGS. **5**CO-**5**CQ.

FIGS. **5**CR-**5**CS illustrate a transition from the screen-on state to the screen-off state that occurs after the user interaction to dismiss notification **592** (e.g., as described with regard to FIGS. **5**BV-**5**BZ). As shown in FIG. **5**CS, because notification clearance criteria are satisfied (e.g., input (to transition the device from the screen-off state to the screen-on state) is received at a time that is (1) after a respective notification of the one or more notifications has been cleared through direct user interaction with the respective notification or an application that corresponds to the respective notification and (2) after the device has transitioned from the screen-on state to the screen-off state at least once since the last direct user interaction that dismissed a respective notification), all notifications have been cleared from wake screen **504**.

In FIG. **5**CR, device **100** has transitioned from the screen-on state, as shown in FIG. **5**CQ, to a screen-off state.

After the screen has transitioned from a screen-off state, as shown in FIG. **5**CR, back to a screen-on state, as shown in FIG. **5**CS (and after the user has interacted with at least one notification, e.g., as described with regard to FIGS. **5**BV-**5**BZ), wake screen user interface **504** is displayed with no notifications.

FIGS. **5**CS-**5**CV illustrate a "rubber band" effect that occurs when an input by a contact with touch screen **112** (as indicated by focus selector **5150**) drags a time/date indicator **582** downward, and then the time/date indicator moves back to its original position in response to lift off of the contact from the touch sensitive surface.

After all notifications have been cleared, as shown at FIG. **5**CS, the cleared notifications can be recalled, as shown at FIGS. **5**CW-**5**CX. FIG. **5**CW illustrates an input (e.g., an upward swipe) that is initiated by a contact with touch screen **112** at a location on wake screen user interface **504**, as indicated by focus selector **5152**. In response to the input, the notifications that were displayed as missed notifications **586**-**592** and subsequently cleared (as described with regard to FIGS. **5**BA, **5**BV-**5**BZ, and **5**CR-**5**CS) move upward when movement of the focus selector **5152** across touch screen **112** has increased above a threshold distance. In FIG. **5**CX, the notifications that were displayed as missed notifications **586**-**592** are displayed as previously received notifications.

FIGS. **5**CY-**5**EB illustrate example user interfaces for displaying updating information from an application in a floating banner, in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **8**A-**8**C. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. In such embodiments, the focus selector is, optionally: a respective finger or stylus contact, a representative point corresponding to a finger or stylus contact (e.g., a centroid of a respective contact or a point associated with a respective contact), or a centroid of two or more contacts detected on the touch-sensitive display system **112**. However, analogous operations are, optionally, performed on a device with a display **450** and a separate touch-sensitive surface **451** in response to detecting the contacts on the touch-sensitive surface **451** while displaying the user interfaces shown in the figures on the display **450**, along with a focus selector.

FIGS. **5**CY-**5**DA illustrate input for activating a navigation mode of a maps application and displaying a navigation banner **5160** that corresponds to the active navigation mode of the maps application.

FIG. **5**CY shows a maps application user interface **5154** displayed by display **112** of device **100**.

In FIG. **5**CZ, an input (e.g., a tap input) by a contact on touch screen **112** is detected at a location that corresponds to a control **5156** for activating a navigation mode of the maps application, as indicated by focus selector **5158**. In response to the input, the navigation mode of the maps application is initiated, and a navigation mode user interface is displayed in maps application user interface **5154**, as indicated at FIG. DA. A navigation banner **5160** (e.g., that includes navigation direction text and/or a navigation direction image, such as a direction arrow) is displayed on the navigation mode user interface of the maps application user interface **5154**.

In FIGS. **5**DB-**5**DF, the "floating" aspect of navigation banner **5160** is illustrated, as navigation banner **5160** continues to be displayed overlying cover sheet user interface **504** (referred to above as wake screen user interface **504**) as cover sheet user interface **504** slides down to cover maps application user interface **5154**. FIGS. **5**DD-**5**DE illustrate how navigation banner **5160** is anchored to time/date object **582** in cover sheet user interface **504**.

FIGS. **5**DB-**5**DF illustrate an input (e.g., a downward swipe) by a contact on touch screen **112** that is initiated at an upper edge of touch screen **112**, as indicated by focus selector **5162**. In response to the input, cover sheet user interface **504** slides down from the upper edge of display **112**, as shown in FIGS. **5**DC-**5**DF. As shown in FIGS. **5**DC-**5**DD, notifications **5164** and **5168** that are displayed on cover sheet user interface **504** descend as cover sheet user interface **504** slides down, while navigation banner **5160** remains at a fixed position on cover sheet **504** (e.g., cover sheet **504** and its notifications **5164** and **5168** appear to slide down behind navigation banner **5160**). As shown in FIGS. **5**DD-**5**DE, in accordance with a determination that cover sheet user interface **504** has descended a threshold distance relative to navigation banner **5160**, navigation banner **5160** becomes "attached" to the cover sheet user interface and begins to move downward while cover sheet user interface **504** moves downward. As shown in FIGS. **5**DD-**5**DF, a time/date object **582** that is displayed on cover sheet user interface **504** is gradually revealed as cover sheet user interface **504** moves downward. In accordance with a determination that the time/date object **582** has reached a predefined location on the display, time/date object **582** and navigation banner **5160** cease to move as the cover sheet user interface **504** continues its descent (and notifications **5164** and **5168** continue to move downward with the cover sheet user interface **504**).

In FIG. **5**DG, the contact indicated by focus selector **5162** has lifted off of cover sheet user interface **504**.

FIGS. **5**DH-**5**DI illustrate input at navigation banner **5160** to display the user interface **5154** of the corresponding maps application.

In FIG. **5**DH, an input (e.g., a tap input) by a contact on touch screen **112** is detected at a location that corresponds to navigation banner **5160**, as indicated by focus selector **5168**. In response to the input, cover sheet user interface **504** ceases to be displayed and maps application user interface **5154** is redisplayed, as indicated at FIG. **5**DI. In FIG. **5**DI, navigation banner **5160** is displayed on the navigation mode user interface of the maps application user interface **5154**.

FIGS. **5**DJ-**5**DS illustrate input to display a home screen user interface **522** (over which navigation banner **5160** continues to be displayed), to pull down cover sheet user interface **504** over home screen user interface **522**, and to show the continuous display of navigation banner **5160** as home screen user interface **522** is revealed from under cover sheet **522**.

FIG. **5**DJ illustrates an input by a contact on touch screen **112** that is initiated by a contact at location that corresponds to home affordance **552**, as indicated by focus selector **5170**. In response to the input, display of map application user interface **5154** is replaced by display of home screen user interface **522**, as shown in FIGS. **5**DJ-**5**DM. Navigation banner **5160** remains displayed at the same position during the transition from displaying map application user interface **5154** to displaying home screen user interface **522**. Navigation banner **5160** is displayed overlaying home screen user interface **522**.

FIGS. **5**DN-**5**DO illustrate an input (e.g., a downward swipe) that is initiated by a contact at a location near the upper edge of touch screen **112**, as indicated by focus selector **5172**. In response to the input, cover sheet user interface **504** slides down from the upper edge of display **112**, as shown in FIGS. **5**DN-**5**DP.

FIG. 5DQ illustrates an input (e.g., an upward swipe input) by a contact on touch screen **112** that is initiated by a contact at location indicated by focus selector **5174**. In response to the input, display of cover sheet user interface **504** is replaced by display of home screen user interface **522**, as shown in FIGS. 5DQ-5DS.

FIG. 5DT-5DW illustrate input that causes transition of navigation banner **5160** from a banner form (as shown in FIG. 5DT) to pill form (as shown in FIG. 5DW).

FIGS. 5DT-5DU illustrate an input (e.g., an upward swipe) that is initiated by a contact at a location that corresponds to navigation banner **5160**, as indicated by focus selector **5176**. In response to the input, navigation banner **5160** gradually transitions from a banner format, as shown in FIG. 5DT, to a pill format, as shown in FIG. 5DW. For example, as navigation banner **5160** gradually transitions from a banner format to a pill format, an animation is displayed in which navigation text **5178** in navigation banner **5160** ceases to be displayed, navigation direction arrow **5180** shrinks, navigation banner **5160** gradually shrinks and moves leftward, and a time **5182** is displayed (e.g., adjacent to navigation direction arrow **5180**) in the pill format of navigation banner **5160**.

FIGS. 5DX-5DW illustrate input on navigation banner **5160** (in the pill format) that causes an application that corresponds to the banner to be displayed.

In FIG. 5DX, an input (e.g., a tap input) by a contact on touch screen **112** is detected at a location that corresponds to navigation banner **5160** (in the pill format), as indicated by focus selector **5184**. In response to the input, because the content of navigation banner **5160** (in the pill format) corresponds to the navigation mode of the map application, home screen user interface **522** ceases to be displayed and maps application user interface **5154** is redisplayed, as indicated at FIG. 5DY. In FIG. 5DY, navigation banner **5160** is displayed on the navigation mode user interface of the maps application user interface **5154**.

FIGS. 5DZ-5EA illustrate banners that are displayed on device **100** when device **100** is in a screen-off state.

In FIG. 5DZ, device **100** has transitioned from the screen-on state, as shown in FIG. 5DY, to a screen-off state. Because the navigation mode of the map application was active when the device **100** transitioned to the screen-off state, navigation banner **5160** is displayed on device **100** while the device is in the "screen-off" state (e.g., aside from displaying the navigation banner **5160**, the display **112** is blank).

In FIG. 5EA, while the device **100** is in the "screen-off" state, a notification **5186** is received. The received notification **5186** is displayed on display **112** of device **100** while the device **100** is in the "screen-off state" (e.g., aside from displaying the received notification **5186** and/or the navigation banner **5160**, the display **112** is blank).

In FIG. 5EB, device **100** has transitioned from the screen-off state, as shown in FIGS. 5DZ-5EA, to a screen-on state, and cover sheet user interface **504** is displayed on the display **112** of device **100**.

FIGS. 5EC-5GU illustrate example user interfaces for navigation using a cover sheet in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. 9A-9C. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. In such embodiments, the focus selector is, optionally: a respective finger or stylus contact, a representative point corresponding to a finger or stylus contact (e.g., a centroid of a respective contact or a point associated with a respective contact), or a centroid of two or more contacts detected on the touch-sensitive display system **112**. However, analogous operations are, optionally, performed on a device with a display **450** and a separate touch-sensitive surface **451** in response to detecting the contacts on the touch-sensitive surface **451** while displaying the user interfaces shown in the figures on the display **450**, along with a focus selector.

FIGS. 5EC1 to 5EC4 illustrate activation of a display (e.g., touch-sensitive display **112**) in response to changing an orientation of device **100**. When the display has been activated, notifications that were received while the device was in a screen-off state were received. These notifications are displayed when the device transitions to a screen-on state. In FIG. 5EC1, the device is in a screen-off state while it is held flat in a user's hand **502**, such that the device display is substantially horizontal. In FIG. 5EC2, the device is tilted such that the display is more vertical than in FIG. 5EC1. Because a tilt angle of the device has not increased above a threshold tilt angle in FIG. 5EC2, the display is not activated. In FIG. 5EC3, the device is tilted such that the display is more vertical than in FIG. 5EC2. Because a tilt angle of the device has increased above a threshold tilt angle in FIG. 5EC3, the display has transitioned from a screen-off state to a screen-on state and wake screen user interface **504** (also referred to herein as a cover sheet user interface **504**) is displayed by the display **112**. In FIG. 5EC4, the display **112** is substantially vertical.

FIG. 5ED illustrates a wake screen user interface **504**, in accordance with some embodiments. Wake screen user interface **504** displays missed notification **5188** that was received and/or generated by device **100** (e.g., while device **100** was in a screen-off state). In some embodiments, wake screen user interface **504** additionally displays controls, such as a subset of controls from a control center user interface **5138** (e.g., a flashlight control **5190** and a camera control **5192**).

In some embodiments, different input criteria must be met to activate a flashlight control **5190** when it is displayed on a wake screen user interface **504** and when it is displayed in a control center user interface **5138**, as illustrated in FIGS. 5EE-5EJ and 5ET-5EW. Because wake screen user interface **504** may be displayed (e.g., in response to tilting the device) at a time when the user does not wish to provide input, more stringent criteria are applied for operating controls displayed on the wake screen user interface to prevent unintentional operation of the controls.

In some embodiments, input that has one effect when it is applied to a control (e.g., camera control **5192**) when it is displayed in control center user interface **5138** has a different effect when the control is displayed in wake screen user interface **504**. For example, a light press input on camera control **5192** causes a menu **5220** to be displayed when camera control **5192** is displayed in control center user interface **5138**, and the light press input on camera control **5192** causes activation of a camera application when camera control **5192** is displayed in wake screen user interface **504**, as illustrated by FIGS. 5EX-5FN.

In some embodiments, a time/date object **582** shifts horizontally as input for navigating from wake screen user interface **504** to adjacent user interfaces (control center user interface **5138** and widget user interface **5140**) to indicate the direction of input needed to return to the wake screen user interface **504**, as illustrate at FIGS. 5EJ-5EP and FIGS. 5EQ-5ES and 5FF-5FH. An overview of the arrangement

wake screen user interface **504** to adjacent user interfaces control center user interface **5138** and widget user interface **5140** is shown in FIG. **5**FR.

FIGS. **5**EE-**5**EG illustrate a first flashlight activation input (e.g., a light press input) by a contact with touch screen **112**, as indicated by focus selector **5194**, at a location that corresponds to a flashlight control **5190** that is displayed on wake screen user interface **504**. In FIG. **5**EE, a characteristic intensity of the contact is above a detection threshold IT_0, as indicated by intensity level meter **5196**, and below a light press intensity level IT_L. In FIG. **5**EF, in accordance with a determination that a characteristic intensity of the contact has increased above a light press intensity threshold, as indicated by IT_L on intensity level meter **5196**, a flashlight is activated, as indicated by flashlight beam **5198**. In FIG. **5**EG, the contact indicated by focus selector **5194** has lifted off of touch screen **112**.

FIGS. **5**EH-**5**EI illustrate a first flashlight deactivation input (e.g., a light press input) by a contact with touch screen **112** at a location that corresponds to flashlight control **5190**, as indicated by focus selector **5200**. In FIG. **5**EI, in accordance with a determination that a characteristic intensity of the contact has increased above a light press intensity threshold, as indicated by IT_L on intensity level meter **5196** while the flashlight is on, the flashlight is shut off. In FIG. **5**EJ, the contact indicated by focus selector **5200** has lifted off of touch screen **112**.

FIGS. **5**EK-**5**EL illustrate an input (e.g., a rightward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5202**. In response to the input, wake screen user interface **504** slides to the right and mini application user interface **5140** is revealed, as shown in FIGS. **5**EK-**5**EM. Mini application user interface **5140** displays mini application objects **583**, **585**, **587**, and **589** that include a subset of content from application. As wake screen user interface **504** slides to the right, time/date object **582** moves from a position in the center of the display **112**, as shown in FIG. **5**EK, to a position at the right of the display **112**, as shown in FIG. **5**EM. Repositioning time/date object **582** provides a visual indication to the user of the direction of the swipe input needed to return to wake screen **504**.

In some embodiments, a mini application object (e.g., as illustrated by mini application objects **583**, **585**, **587**, and **589**) is configured to perform a subset, less than all, of the functions of a corresponding application. In some embodiments, a mini application object displays an identifier for the corresponding application. In some embodiments, a mini application object displays a portion of the content the corresponding application. In some embodiments, a predefined input on a mini application object launches the corresponding application. In some embodiments, a mini application object operates as a standalone application residing in memory of the device, distinct from an associated application also residing in the memory of the device. For example, a mini application object corresponding to a social networking application operates as a single-purpose or streamlined application with a subset, less than all, of the functionality of the corresponding application, but is associated with the full-featured social networking application. In this example, the mini application object operates independently of the social networking application, and in a scenario where the social networking application is not running, the mini application object continues to operate. In some embodiments, a mini application object operates as an extension or component of an associated application on the device.

FIGS. **5**EN-**5**EO illustrate an input (e.g., a leftward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5204**. In response to the input, mini application user interface **5140** slides to the left and wake screen user interface **504** is revealed, as shown in FIG. **5**EN-**5**EP. As mini application user interface **5140** slides to the left, time/date object **582** moves from a position in at the right of the display **112**, as shown in FIG. **5**EN, to a position in the center of the display **112**, as shown in FIG. **5**EP. Repositioning time/date object **582** provides a visual indication to the user of the direction of the swipe input needed to return to wake screen **504**.

FIGS. **5**EQ-**5**ER illustrate an input (e.g., a leftward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5206**. In response to the input, wake screen user interface **504** slides to the left and control center user interface **5138** is revealed, as shown in FIG. **5**EQ-**5**ES. As wake screen user interface **5140** slides to the left, time/date object **582** moves from a position in at the center of the display, as shown in FIG. **5**EQ, to a position at the left of the display, as shown in FIG. **5**ES. Repositioning time/date object **582** provides a visual indication to the user of the direction of the swipe input needed to return to wake screen **504**.

FIG. **5**ET illustrates a second flashlight activation input (e.g., a tap input) by a contact with touch screen **112**, as indicated by focus selector **5208**, at a location that corresponds to a flashlight control **5190** that is displayed on control center user interface **5138**. In response to the input, a flashlight is activated, as indicated by flashlight beam **5210** in FIG. EU. Because a wake screen user interface **504** is displayed on waking the device (e.g., when the device is tilted as described with regard to FIGS. **5**EC**1**-**5**EC**4**), input that meets threshold intensity criteria (e.g., light press intensity criteria) is needed to activate the flashlight using a flashlight control **5190** displayed in the wake screen user interface **504**. In this way, accidental activation of the flashlight is avoided. When the user has provided input to navigate to control center user interface **5138**, a tap input (as described with regard to FIGS. **5**ET-**5**EU) is sufficient to activate the flashlight.

FIG. **5**EV illustrates a second flashlight deactivation input (e.g., a tap input) by a contact with touch screen **112** at a location that corresponds to flashlight control **5190**, as indicated by focus selector **5212**. In response to the input, the flashlight is shut off, as indicated at FIG. **5**EW.

FIG. **5**EX illustrates a control center camera application activation input (e.g., a tap input) by a contact with touch screen **112**, as indicated by focus selector **5214**, at a location that corresponds to a camera control **5192** that is displayed on control center user interface **5138**. In response to the control center camera application activation input, display of the control center user interface **5138** is replaced by display of a camera application user interface **5216**, as shown in FIG. **5**EY.

FIGS. **5**EZ-**5**FB illustrate camera menu display input (e.g., a light press input) by a contact with touch screen **112**, as indicated by focus selector **5218**, at a location that corresponds to a camera control **5192** that is displayed on control center user interface **5138**. In FIG. **5**FA, a characteristic intensity of the contact is above a detection threshold IT_0, as indicated by intensity level meter **5196**, and below a light press intensity level IT_L. In FIG. **5**FB, in accordance with a determination that a characteristic intensity of the contact increases above a light press intensity threshold, as

indicated by IT_L on intensity level meter **5196**, a camera menu **5220** is displayed overlaying control center user interface **5138**.

In FIG. **5**FC, the contact indicated by focus selector **5218** has lifted off from touch screen **112**.

In FIG. **5**FD, an input (e.g., a tap input) by a contact on touch screen **112** is detected at a location outside of camera menu **5220**, as indicated by focus selector **5222**. In response to the input, camera menu **5220** ceases to be displayed overlaying control center user interface **5138**, as shown in FIG. **5**FE.

FIGS. **5**FF-**5**FG illustrate an input (e.g., a rightward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5224**. In response to the input, control center user interface **5138** slides to the right and wake screen user interface **504** is redisplayed, as shown in FIGS. **5**FG-**5**FH. As control center user interface **5138** slides to the right, time/date object **582** moves from a position in the left of the display, as shown in FIG. **5**FF, to a position at the center of the display, as shown in FIG. **5**FH.

FIG. **5**FI illustrates an input (e.g., a tap input) by a contact with touch screen **112**, as indicated by focus selector **5226**, at a location that corresponds to a camera control **5192** that is displayed on wake screen user interface **504**. As shown in FIGS. **5**FI-**5**FJ, a tap input on camera control **5192** that is displayed on wake screen user interface **504** has no effect (unlike a tap input on camera control **5192** displayed in control center user interface **5138**, which causes a camera application user interface **5216** to be displayed, as discussed with regard to FIGS. **5**EX-**5**EY).

Whereas a light press input on a camera control displayed in control center user interface **5138** causes a camera menu **5220** to be displayed, a light press input on a camera control displayed in wake screen user interface **504** causes a camera application user interface **5216** to be displayed. FIGS. **5**FK-**5**FL illustrate a wake screen camera activation input (e.g., a light press input) by a contact with touch screen **112**, as indicated by focus selector **5228**, at a location that corresponds to a camera control **5192** that is displayed on wake screen user interface **504**. In FIGS. **5**FK-**5**FL, a characteristic intensity of the contact is above a detection threshold IT_0, as indicated by intensity level meter **5196**, and below a light press intensity level IT_L. In FIG. **5**FM, in accordance with a determination that a characteristic intensity of the contact has increased above a light press intensity threshold, as indicated by IT_L on intensity level meter **5196**, display of the wake screen user interface **504** is replaced by display of a camera application user interface **5216**.

FIGS. **5**FN-**5**FT illustrate that, in response to authentication input (e.g., as shown in FIG. **5**FP, additional notification information is displayed on wake screen user interface **504**.

FIG. **5**FN illustrates an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated at a lower edge of touch screen **112**, as indicated by focus selector **5230**. In response to the input, in accordance with a determination that the device is locked, an authentication user interface **518** is displayed, as shown in FIG. **5**FO.

In FIG. **5**P, an authentication input (e.g., a tap input) by a contact on touch screen **112** is detected at a location within authentication user interface **518**, as indicated by focus selector **5232**. In response to the authentication input, the device is unlocked and home screen user interface **522** is displayed, as shown in FIG. **5**FQ.

FIG. **5**FR illustrates an input (e.g., a downward swipe) that is initiated by a contact at a location near the upper edge of touch screen **112**, as indicated by focus selector **5232**. In response to the input, wake screen user interface **504** slides down from the upper edge of display **112**, as shown in FIGS. **5**FR-**5**FT. When wake screen user interface **504** is displayed while device **100** is unlocked, as shown in FIG. **5**FT, notification **5188** is displayed with information (e.g., message text **5234** and an image **5236**) that were not displayed while device **100** was locked (see, e.g., FIG. **5**ED), and an additional notification **5190** is displayed.

FIG. **5**FU illustrates an arrangement of wake screen user interface **504** and adjacent user interfaces control center user interface **5138** and widget user interface **5140**. As discussed above with regard to FIGS. **5**EK-**5**EP, a rightward swipe on wake screen user interface **504** causes widget user interface **5140** to be displayed, and a leftward swipe on widget user interface **5140** causes wake screen user interface **504** to be displayed. As discussed above with regard to FIGS. **5**EQ-**5**ES and FIGS. **5**FF-**5**FH, a leftward swipe on wake screen user interface **504** causes control center user interface **5138** to be displayed, and a rightward swipe on control center user interface **5138** causes wake screen user interface **504** to be displayed. An upward swipe on wake screen user interface **504** causes a previously displayed user interface (e.g., home screen user interface **522**, an application user interface, or a settings user interface) to be displayed.

As illustrated in FIGS. **5**FV-**5**GB, when input to display widget user interface **5140** or control center user interface **5138** is received, the state of a user interface that is adjacent to wake screen user interface **504** being displayed is not "sticky," in that when widget user interface **5140** or control center user interface **513** are displayed and subsequently dismissed, a subsequent downward swipe input from the upper edge of display **112** will cause wake screen user interface **504** (and not widget user interface **5140** or control center user interface **513**) to be displayed.

FIGS. **5**FV-**5**FW illustrate an input (e.g., a rightward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5238**. In response to the input, wake screen user interface **504** slides to the right and mini application user interface **5140** is revealed, as shown in FIGS. **5**FV-**5**FX.

FIG. **5**FY illustrates an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated at a lower edge of touchscreen **112** by a contact at location that is indicated by focus selector **5240**. In response to the input, display of mini application user interface **5140** is replaced by display of home screen user interface **522**, as shown in FIGS. **5**FY-**5**FZ.

In FIGS. **5**FZ-**5**GB, after an input is received for navigation to a user interface that is adjacent to wake screen user interface **504** (e.g., to navigate to mini application user interface **5140** or control center user interface **5138**) and a subsequent input is received to dismiss the user interface that is adjacent to wake screen user interface **504** (e.g., the input in FIG. **5**FY to reveal home screen **522**), a downward swipe reveals wake screen user interface **504** (and not the adjacent interface that was displayed prior to the dismissal input). For example, in FIG. **5**FZ, an input (e.g., a downward swipe) is initiated by a contact at a location near the upper edge of touch screen **112**, as indicated by focus selector **5242**. In response to the input, wake screen user interface **504** (and not mini application user interface **5140**) slides down from the upper edge of display **112**, as shown in FIGS. **5**FZ-**5**GB.

FIGS. **5**GC-**5**GP illustrate input to display a maps application, activate a navigation mode of the maps application and display a navigation banner **5160**, and transition the

navigation banner **5160** from a pill form, as shown in FIG. **5**FM, to a banner form, as shown in FIG. **5**GP, in accordance with some embodiments.

FIG. **5**GC illustrates an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated by a contact at location that corresponds to home affordance **552**, as indicated by focus selector **5244**. In response to the input, display of wake screen user interface **504** is replaced by display of home screen user interface **522**, as shown in FIGS. **5**GC-**5**GD.

In FIG. **5**GE, an input (e.g., a tap input) is detected at a location that corresponds to affordance **5248** for displaying a maps application interface, as indicated by focus selector **5246**. In response to the input, a maps application user interface **5154** is displayed, as shown in FIG. **5**GF.

In FIG. **5**GH, an input (e.g., a tap input) by a contact on touch screen **112** is detected at a location that corresponds to a control **5156** for activating a navigation mode of the maps application, as indicated by focus selector **5250**. In response to the input, the navigation mode of the maps application is initiated, and a navigation mode user interface is displayed in maps application user interface **5154**, as indicated at FIG. **5**GI.

FIG. **5**GJ illustrates an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated by a contact at location that corresponds to home affordance **552**, as indicated by focus selector **5252**. In response to the input, display of wake screen user interface **504** is replaced by display of home screen user interface **522**, as shown in FIGS. **5**GK-**5**GL. In FIG. **5**GL, a navigation banner **5160** is displayed in a pill format within home screen user interface **522**.

FIGS. **5**GM-**5**GO illustrate an input (e.g., a downward swipe) that is initiated by a contact at a location near the upper edge of touch screen **112**, as indicated by focus selector **5254**. In response to the input, wake screen user interface **504** slides down from the upper edge of display **112**, as shown in FIGS. **5**GM-**5**GP. As wake screen user interface **504** slides down, navigation banner **5160** transitions from a pill format, as shown in FIG. **5**GM, to a banner format, as shown in FIG. **5**GP. For example, as navigation banner **5160** gradually transitions from a pill format to a banner format, an animation is displayed in which navigation text **5178** is displayed in navigation banner **5160**, navigation direction arrow **5180** grows, navigation banner **5160** gradually grows and moves toward the center of display **112**, and time **5182** ceases to be displayed.

From FIG. **5**GP to FIG. **5**GQ, the information displayed in navigation banner **5160** has updated (e.g., in accordance with a changed location of the phone as the user proceeds along the navigation route), indicating that the content of navigation banner **5160** updates (e.g., in real time) while navigation banner **5160** is displayed.

FIG. **5**GR illustrates an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated at a location near the lower edge of touch screen **112**, as indicated by focus selector **5256**. In response to the input, wake screen user interface **504** slides up from the lower edge of display **112** to redisplay the underlying maps user interface **5154** (that was previously covered by wake screen user interface **504**).

FIG. **5**GT illustrates an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated by a contact at location that corresponds to home affordance **552**, as indicated by focus selector **5258**. In response to the input, display of wake screen user interface **504** is replaced by display of home screen user interface **522**, as shown in FIGS. **5**GT-**5**GU. In FIG. **5**GU, because the navigation mode of maps application **5154** is still active, a navigation banner **5160** is displayed in a pill format within home screen user interface **522**.

From FIG. **5**GL to FIG. **5**GU, the information displayed in the pill format version of navigation banner **5160** has updated (e.g., in accordance with a changed location of the phone as the user proceeds along the navigation route), indicating that the content of the pill format version of navigation banner **5160** updates (e.g., in real time) while navigation banner **5160** is displayed.

In FIGS. **5**GV-**5**GW, the color of one or more objects on wake screen user interface **504** (e.g., time/date object **582**, navigation banner **5188**, notification **5188**, and/or notification **5234**) are altered in accordance with a change in a background color and/or image of wake screen user interface **504**.

FIGS. **5**GX-**5**HR illustrate a panel-based cover sheet user interface **5260** (e.g., a wake screen displayed on a device with a large format display, such as a tablet device). In some embodiments, when panel-based cover sheet user interface **5260** is dismissed and subsequently recalled, a state of the panel-based cover sheet user interface **5260** when panel-based cover sheet user interface **5260** is recalled is the same as the state of panel-based cover sheet user interface **5260** prior to the dismissal.

In FIG. **5**GX, panel-based cover sheet user interface **5260** is displayed on display **112**. A notification panel **5262** is displayed on panel-based cover sheet user interface **5260**.

FIGS. **5**GY-**5**GZ illustrate an input (e.g., a rightward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5264**. In response to the input, notification panel **5262** slides to the right and a mini application panel **5266** is revealed, as shown in FIGS. **5**GZ-**5**HA. In FIG. **5**HA, notification panel **5262** and mini application panel **5266** are simultaneously displayed on panel-based cover sheet user interface **5260**.

FIGS. **5**HB-**5**HC illustrate an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated at a lower edge of touchscreen **112** by a contact at location that is indicated by focus selector **5268**. In response to the input, panel-based cover sheet user interface **5260** slides upward to reveal home screen user interface **522**, as shown in FIGS. **5**HB-**5**HD.

FIGS. **5**RE-**5**HF illustrate an input (e.g., a downward swipe) by a contact on touch screen **112** that is initiated at an upper edge of touchscreen **112** by a contact at location that is indicated by focus selector **5272**. In response to the input, panel-based cover sheet user interface **5272** slides downward over home screen user interface **522**, as shown in FIGS. **5**HE-**5**HG. Notification panel **5262** and mini application panel **5266**, which were simultaneously displayed on panel-based cover sheet user interface **5260** prior to dismissal of panel-based cover sheet user interface **5272**, continue to be displayed when panel-based cover sheet user interface **5260** is redisplayed.

FIGS. **5**HH-**5**HI illustrate an input (e.g., a leftward swipe) that is initiated by a contact on touch screen **112**, as indicated by focus selector **5274**. In response to the input, notification panel **5274** slides to the left, until notification panel **5274** ceases to be displayed, and a control center panel **5278** is revealed, as shown in FIGS. **5**HH-**5**HL. In FIG. **5**HL, notification panel **5262** and control center panel **5278** are simultaneously displayed on panel-based cover sheet user interface **5260**.

FIGS. **5**HM-**5**HN illustrate an input (e.g., an upward swipe) by a contact on touch screen **112** that is initiated at

a lower edge of touchscreen **112** by a contact at location that is indicated by focus selector **5278**. In response to the input, panel-based cover sheet user interface **5260** slides upward to reveal home screen user interface **522**, as shown in FIGS. **5**HM-**5**HO.

FIGS. **5**HP-**5**HF illustrate an input (e.g., a downward swipe) by a contact on touch screen **112** that is initiated at an upper edge of touchscreen **112** by a contact at location that is indicated by focus selector **5280**. In response to the input, panel-based cover sheet user interface **5272** slides downward over home screen user interface **522**, as shown in FIGS. **5**HP-**5**HR. Notification panel **5262** and control center panel **5278**, which were simultaneously displayed on panel-based cover sheet user interface **5260** prior to dismissal of panel-based cover sheet user interface **5272**, continue to be displayed when panel-based cover sheet user interface **5260** is redisplayed.

FIGS. **6**A-**6**G are flow diagrams illustrating method **600** of clearing sets of notifications, in accordance with some embodiments. Method **600** is performed at an electronic device (e.g., device **300**, FIG. **3**, or portable multifunction device **100**, FIG. **1**A) with a display, a touch-sensitive surface, and one or more sensors to detect intensity of contacts with the touch-sensitive surface. In some embodiments, the display is a touch-screen display and the touch-sensitive surface is on or integrated with the display. In some embodiments, the display is separate from the touch-sensitive surface. Some operations in method **600** are, optionally, combined and/or the order of some operations is, optionally, changed.

As described below, method **600** provides an intuitive way to clear sets of notifications. The method reduces the number, extent, and/or nature of the inputs from a user when clearing sets of notifications, thereby creating a more efficient human-machine interface. For battery-operated electronic devices, enabling a user to clear sets of notifications faster and more efficiently conserves power and increases the time between battery charges.

While the device is in a screen-off state (e.g., as shown in FIGS. **5**A**1**-**5**A**2**), the device receives (**602**) one or more notifications.

After receiving the one or more notifications (e.g., while the device remains in the screen-off state, or while the one or more notifications are displayed on a dark screen of the screen-off state), the device detects (**604**) a first input from a user for waking the device from the screen-off state to a screen-on state (e.g., the device detects a state change indicating that the device has been picked up, as described with regard to FIGS. **5**A**1**-**5**A**4**, or the device detects an input at a control, such as push button **106**, for waking the device).

In response to detecting the first input for waking the device from the screen-off state to the screen-on state, the device (**606**): transitions the device from the screen-off state to the screen-on state (e.g., as shown at FIGS. **5**A**2**-**5**A**3**), displays a wake screen user interface **504** on the display **112** (as shown in FIGS. **5**A**3** and **5**B), and displays the one or more notifications (e.g., notifications **506**, **508**, **510**, and **512** shown in FIG. **5**B) on the wake screen user interface **504** (e.g., the notifications are displayed as a list of notification banners below a time-date object **582**). These notifications are sometimes also referred to as "missed notifications" because they were received while the device was in the screen-off state. In some embodiments, the wake screen user interface **504** is also a cover sheet user interface that is displayed to cover a currently displayed user interface when a downward edge swipe gesture (e.g., a downward swipe that starts from an upper edge of the touch-sensitive surface

112) is detected on the display **112**. In some embodiments, the wake screen user interface **504** includes a time-date object **582** showing the current time and date, and/or one or more prompts or affordances for unlocking the device from a locked state to an unlocked state.

While displaying the wake screen user interface **504** and while at least one of the one or more notifications remains displayed on the wake screen user interface **504** (e.g., at a later time after the user has interacted with the device which may include interactions that cause the dismissal and then redisplay of the wake screen user interface one or more times), the device detects (**608**) a second input for dismissing the wake screen user interface (e.g., an upward swipe input to reveal an underlying user interface or an input (e.g., on a power button) to shut off the display).

In response to detecting the second input for dismissing the wake screen user interface, the device ceases (**610**) to display the wake screen user interface **504** and the at least one of the one or more notifications (e.g., notifications **506**, **508**, **510**, and **512** shown in FIG. **5**B). In some embodiments, the device reveals an underlying interface such as a home screen user interface **522**, a settings user interface, or an application user interface (e.g., messages user interface **530**, web browser user interface **540**, music user interface **560**, or maps user interface **5154**.

After ceasing to display the wake screen user interface **504** and the at least one of the one or more notifications in response to the second input, the device detects (**612**) a third input for redisplaying the wake screen user interface (e.g., the third input may be an input for waking the device again after the device has transitioned back to the screen-off state, or an input (e.g., a downward swipe from the top of the touch-screen) for redisplaying the wake screen user interface after the wake screen user interface has been dismissed while the device remains in the screen-on state).

In response to detecting the third input for redisplaying the wake screen user interface **504** (**614**), in accordance with a determination that the third input meets notification-clearance criteria (e.g., notification-clearance criteria are criteria for completely removing all remaining missed notifications from the wake screen user interface and, optionally, deleting the notifications or saving them to notification history), the device redisplays the wake screen user interface **504** without displaying the at least one of the one or more notifications on the redisplayed wake screen user interface **504** (e.g., all previously displayed missed notifications are cleared from the wake screen user interface). The notification-clearance criteria require that the third input is detected at a time that is (1) after a respective notification of the one or more notifications has been cleared through direct user interaction with the respective notification or an application that corresponds to the respective notification and (2) after the device has transitioned from the screen-on state to the screen-off state at least once since the detection of the second input (e.g., since the last input for dismissing the wake screen user interface was detected). Examples of user interaction with the respective notification include an input to activate a displayed deletion control, such as an "x" icon displayed adjacent to the notification (e.g., a tap gesture by a contact at a location that corresponds to the displayed control), an input (such as a deep press or swipe gesture) on the notification to dismiss or delete the notification or to reveal a control for dismissing the notification followed by an input to activate a control for dismissing the notification, or an input to open the notification in an application (e.g., a tap gesture by a contact at a location that corresponds to the notification). For example, the input described with regard to

FIGS. **5**AV-**5**AW (e.g., the input to wake the device) is detected at a time that is detected at a time that is (1) after a respective notification of the one or more notifications has been cleared through direct user interaction with the respective notification or an application that corresponds to the respective notification (e.g., described with regard to FIGS. **5**L-**5**P and FIGS. **5**Y-**5**AC) and (2) after the device has transitioned from the screen-on state to the screen-off state at least once since the detection of the second input (e.g., as described with regard to FIGS. **5**AU-**5**AW). In accordance with a determination that the third input does not meet the notification-clearance criteria: the device redisplays the wake screen user interface, and redisplays the at least one of the one or more notifications on the redisplayed wake screen user interface (e.g., continuing to display all of the notifications that were not dismissed by the user through direct user interaction (e.g., all or a subset of all the missed notifications that were received during the screen-off state)).

This heuristic allows a device to either automatically clear a set of missed notifications or to redisplay a set of missed notifications displayed on a wake screen depending on whether notification-clearance criteria are met. Automatically clearing a set of missed notifications in accordance with a determination that notification-clearance criteria are met makes the user-device interface more efficient and enhances the operability of the device by providing the user with the ability to clear multiple notifications without requiring the user to manually dismiss each notification, while retaining the ability of the user to individually clear missed notifications in the set of multiple notifications (e.g., by maintaining the device in a screen-on session while interacting with the individual notifications). Enabling the user to use the device more quickly and efficiently reduces power usage and improves battery life of the device.

In some embodiments, in response to detecting the third input for redisplaying the wake screen user interface, and in accordance with the determination that the third input does not meet the notification-clearance criteria (**616**), in accordance with a determination that one or more notification-clearance interactions have occurred (e.g., through a direct user interaction with a notification or interaction with an application that corresponds to a notification), the device forgoes display of one or more notifications that are cleared by the one or more notification-clearance interactions on the redisplayed wake screen user interface **504**. For example, notification-clearance interactions are described with regard to to FIGS. **5**L-**5**P and FIGS. **5**Y-**5**AC. In FIG. **5**P, notification **510** is not displayed due to interaction with notification **510** that occurred in FIG. **5**L (to cause display of messages application **530**). In FIG. **5**AC, notification **506** is not displayed due to the interaction with notification **506** that occurred in Figure AB (to cause deletion of the notification). In some embodiments, in accordance with a determination that no notification-clearance interactions have occurred, all of the one or more notifications are redisplayed on the redisplayed wake screen user interface.

Forgoing display of one or more notifications that are cleared by the one or more notification-clearance interactions on the redisplayed wake screen user interface reduces the amount of information displayed on the redisplayed wake screen. Reducing the amount of information displayed on the redisplayed wake screen makes the user-device interface more efficient and enhances the operability of the device by allowing a user to access notification information that the user has not previously reviewed without having to navigate past information that the user has previously reviewed.

In some embodiments, after detecting the first input for waking the device from the screen-off state to the screen-on state and prior to detecting the second input for dismissing the wake screen user interface (**618**), the device detects a plurality of intermediate inputs, the plurality of intermediate inputs including: a first intermediate input for dismissing the wake screen user interface (in response to which the wake screen is dismissed and a background user interface is revealed, or in response to which the device goes into the screen-off state and the screen is dark with no interface displayed), and a second intermediate input for redisplaying the wake screen user interface (in response to which the wake screen is redisplayed over a currently displayed user interface, or in response to which the device is woken to the screen-on state and the wake-screen user interface is displayed as soon as the display is turned on). For example, in FIGS. **5**B-**5**C, the device transitions from a screen-on state to a screen-off state (e.g., in response to a user input to shut off the display), and at FIGS. **5**C-**5**D, the device transitions back to a screen-on state (e.g., in response to a user input to wake the display). In FIGS. **5**Q-**5**R, wake screen **504** is dismissed, and in FIGS. **5**V-**5**X, wake screen **504** is redisplayed.

Maintaining display of a set of missed notifications after detecting intermediate inputs for dismissing and redisplaying a wake screen user interface makes the user-device interface more efficient and enhances the operability of the device by allowing a user to display the wake screen repeatedly (e.g., to view the time or check for an incoming notification) while maintaining a list of missed notifications for the user to handle when the user is ready to interact with the notifications (without requiring the user to provide input for redisplaying the missed notifications while the wake screen is displayed).

In some embodiments (**620**), the second input for dismissing the wake screen user interface is an input for displaying a first user interface (e.g., an application user interface such as messages user interface **530** or music user interface **560**, a settings management user interface, a springboard user interface (home screen user interface **522**) that includes a plurality of application launch icons, etc.) that is distinct from the wake screen user interface, the first user interface is displayed in response to the second input (e.g., after the wake screen user interface is dismissed, the first user interface is revealed from underneath the wake screen user interface), and the third input for redisplaying the wake screen user interface was received while the first user interface is displayed. For example, in FIGS. **5**L-**5**M, an wake screen user interface **504** is dismissed in response to user input that causes messages user interface **530** to be displayed. While messages user interface **530** is displayed, input to redisplay wake screen user interface is received as described with regard to FIGS. **5**N-**5**P.

Redisplaying the wake screen in response to input received while a first user interface (such as an application user interface, a springboard user interface, or a settings management user interface) is displayed allows a user to access the wake screen (and any missed notifications displayed on the wake screen) at all times while using the device. This makes the user-device interface more efficient and enhances the operability of the device by allowing a user to access the wake screen without requiring the user to navigate through multiple interfaces to gain access to the wake screen).

In some embodiments (**622**), the third input for redisplaying the wake screen user interface **504** is received while a content playback application is active (e.g., in response to an

activation input as described with regard to FIG. **5**AK), and redisplaying the wake screen user interface includes displaying (e.g., above the one or more missed notifications) at least one media playback control **572** (e.g., in a media playback control panel **568**) in the wake screen user interface **504**. In some embodiments, the playback controls are displayed on the wake screen user interface **504** whenever the wake screen user interface is displayed while the content playback application is active (e.g., media playback is ongoing).

Displaying at least one media playback control on the wake screen user interface (e.g., in addition to the time and/or missed notifications) while a content playback application is active allows a user to control playback via the displayed media playback control immediately upon waking the device, or by accessing the wake screen at any time while using the device. This makes the user-device interface more efficient and enhances the operability of the device by allowing a user to view the time and/or missed notifications while accessing the device to control media playback without needing to unlock the device and/or navigate through multiple interfaces.

In some embodiments, while the wake screen user interface **504** is displayed, the device detects (**624**) a fourth input by a contact on the touch-sensitive surface, including detecting movement of the contact along the touch-sensitive surface in a first direction (e.g., downwards) and detecting lift-off of the contact after the movement (e.g., as described with regard to FIGS. **5**AW-**5**AZ). In response to detecting the fourth input, the device: moves at least one object (e.g., an object **582** that displays a current time and/or date) displayed on the wake screen user interface **504** (e.g., in the first direction) in accordance with the movement of the contact, and reverses the movement of the at least one object (e.g., moving in a second direction opposite the first direction, e.g., upwards) upon lift-off of the contact.

Providing visual feedback, such as a "rubber band effect" simulated by moving at least one object in accordance with movement of a contact and reversing the movement of the at least one object upon lift-off of the contact, enhances operability of the device by providing an intuitive indication to the user that the wake screen is responsive to input such as a swipe input) to view additional notifications and thereby helping the user to provide proper inputs to achieve a desired outcome. The indication is intuitive because the user receives the information without the need to display additional instruction to the user for understanding the feature).

In some embodiments, while displaying the one or more notifications on the wake screen user interface, the device detects (**626**) a fifth input by a contact on the touch-sensitive surface (e.g., a tap input) at a location that corresponds to a first notification of the one or more notifications. In response to detecting the fifth input, the device ceases to display the wake screen user interface and displays a first application user interface for a first application that corresponds to the first notification. For example, in FIG. **5**L, an input at a location that corresponds to notification **510** is detected. In FIG. **5**M, in response to the detected input, messages application user interface **530** is displayed.

Displaying an application user interface for an application that corresponds to a notification in response to input detected at a location that corresponds to the notification makes the user-device interface more efficient and enhances the operability of the device by allowing a user to interact with an application with minimal input immediately upon waking the device or otherwise accessing a missed notification on the wake screen user interface.

In some embodiments, while displaying the first application user interface for the first application that corresponds to the first notification (e.g., messages application user interface **530**, as shown in FIGS. **5**M-**5**N), the device detects (**628**) a sixth input for redisplaying the wake screen user interface (e.g., an input as described with regard to FIGS. **5**N-**5**O). In response to detecting the sixth input for redisplaying the wake screen user interface, the device ceases to display the first application user interface (e.g., as shown in FIG. **5**O), displays the wake screen user interface (e.g., as shown in FIG. **5**P), displays at least one second notification of the one or more notifications on the wake screen user interface (e.g., notifications **506**, **508**, and **512**), wherein the at least one second notification corresponds to a second application that is distinct from the first application, and forgoes display of the first notification (and, optionally, any other notifications among the one or more missed notifications that correspond to the first application) on the wake screen user interface **504** with the at least one second notification. For example, in FIG. **5**P, notification **510** is no longer displayed.

Forgoing display of a notification on the wake screen user interface after displaying an application interface of an application that corresponds to the notification reduces the amount of information displayed on the redisplayed wake screen. Reducing the amount of information displayed on the redisplayed wake screen makes the user-device interface more efficient and enhances the operability of the device by allowing a user to access notification information that the user has not previously reviewed without having to navigate past information that the user has previously reviewed (e.g., when accessing an application interface for an application that corresponds to the notification).

In some embodiments, after detecting the sixth input, while displaying the wake screen user interface **504**, the device detects (**630**) a seventh input for dismissing the wake screen user interface (e.g., including detecting an upward swipe gesture on the touch-sensitive surface). In response to detecting the seventh input for dismissing the wake screen user interface, the device ceases to display the wake screen user interface (e.g., by pulling the wake screen user interface **504**, which is used as a "cover sheet" user interface, upward), and redisplays the first application user interface for the first application. For example, FIGS. **5**Q-**5**R show an input that causes wake screen user interface **504** to slide up to reveal the underlying messages application user interface **530**.

Redisplaying a last displayed user interface after dismissing the wake screen user interface allows the user to return to a previous operating context without requiring multiple inputs, thereby making the user-device interface more efficient (e.g., by reducing the number of inputs needed to return to a previously viewed user interface).

In some embodiments, while the first application user interface for the first application (e.g., messages user interface **530** for a messages application) is redisplayed, the device detects (**632**) an eighth input (e.g., as described with regard to FIGS. **5**S-**5**T) for invoking a third application that is distinct from the first application and the second application. In response to detecting the eighth input for invoking the third application, the device displays a third application user interface of the third application (e.g., browser application user interface **540** for a web browser application). After detecting the eighth input, while displaying the third application user interface, the device detects a ninth input (e.g., as described with regard to FIG. **5**V-**5**W) for redisplaying the wake screen user interface (e.g., including

detecting a downward edge swipe gesture (e.g., a downward swipe that starts from an upper edge of the touch-sensitive surface **112**)). In response to detecting the ninth input for redisplaying the wake screen user interface **504**, the device ceases to display the third application user interface, displays the wake screen user interface **504** (e.g., pull down the wake screen user interface over the second application user interface), and redisplays the at least one second notification of the one or more notifications on the wake screen user interface without redisplaying the first notification (or, optionally, any missed notifications that correspond to the first application and the third application). For example, in FIG. **5**X, wake screen **504** is displayed with notifications **506**, **508**, and **512**.

Maintaining display of a set of missed notifications after detecting intermediate inputs for dismissing and redisplaying a wake screen user interface makes the user-device interface more efficient and enhances the operability of the device by allowing a user to display the wake screen repeatedly (e.g., to view the time or check for an incoming notification) while maintaining a list of missed notifications for the user to handle when the user is ready to interact with the notifications (without requiring the user to provide input for redisplaying the missed notifications while the wake screen is displayed).

In some embodiments, after displaying the at least one second notification without displaying the first notification on the wake screen user interface (e.g., in FIG. **5**AU, notifications **508** and **512** are displayed and notifications **506** and **510** are no longer displayed), the device detects (**634**) a first transition from the screen-on state to the screen-off state (e.g., the transition is triggered when an amount of time that has passed since a last input was received increased above a threshold time, or when an input is received at a control for shutting off the display) followed by a second transition from the screen-off state to the screen-on state (e.g., when an input is received to wake the device or turn on the display). For example, FIGS. **5**AU-**5**AV illustrate a transition from the screen-on state to the screen-off state and FIGS. **5**AV-**5**AW illustrate a transition from the screen-off-state to the screen-on state. In response to detecting the first transition followed by the second transition: the device redisplays the wake screen user interface without displaying any of the one or more notifications on the wake screen user interface (e.g., the notification-clearance criteria are met, and all of the missed notifications that were still remaining on the wake screen are now cleared). For example, in FIG. **5**AW, no notifications are displayed.

Automatically clearing a set of missed notifications in accordance with a determination that notification-clearance criteria are met makes the user-device interface more efficient and enhances the operability of the device by providing the user with the ability to clear multiple notifications without requiring the user to manually dismiss each notification. Enabling the user to use the device more quickly and efficiently reduces power usage and improves battery life of the device.

In some embodiments, while displaying the wake screen user interface with all of the one or more notifications (e.g., before the user interacted with one of the notifications or opened an application that corresponds to one of the one or more notifications), the device detects (**636**) a third transitioning from the screen-on state to the screen-off state (e.g., the transition is triggered when an amount of time that has passed since a last input was received increased above a threshold time, or when an input is received at a control for shutting off the display) followed by a fourth transition from the screen-off state to the screen-on state (e.g., when an input is received to wake the device or turn on the display). For example, a transition from the screen-on state to the screen-off state is shown in FIGS. **5**B-**5**C and a transition from the screen-off state to the screen-on state is shown in FIGS. **5**C-**5**D. In response to detecting the third transition followed by the fourth transition, the device redisplays the wake screen user interface with the one or more notifications on the wake screen user interface (e.g., all of the missed notifications still remain on the wake screen). For example, in FIG. **5**D, all of the notifications **506**-**512** displayed in FIG. **5**B are redisplayed.

Maintaining display of a set of missed notifications after a transition from the screen-on state to the screen-off state followed by a transition from the screen-off state to the screen-on state makes the user-device interface more efficient and enhances the operability of the device by allowing a user to display the wake screen repeatedly (e.g., to view the time or check for an incoming notification) while maintaining a list of missed notifications for the user to handle when the user is ready to interact with the notifications (without requiring the user to provide input for redisplaying the missed notifications while the wake screen is displayed).

In some embodiments, while displaying the wake screen user interface with the one or more notifications, the device detects (**638**) a tenth input (e.g., an upward swipe gesture on the touch-sensitive surface) for displaying an authentication user interface **518** (e.g., including a password input prompt, such as a number pad). In response to detecting the tenth input for displaying the authentication user interface: the device ceases to display the wake screen user interface **504** and displays the authentication user interface **518**. For example, in response to an input described with regard to FIG. **5**E, authentication user interface **518** is displayed in FIG. **5**F. While the authentication user interface **518** is displayed, the device detects an authorization input (e.g., a passcode entered via the number pad). In accordance with a determination that the authorization input is valid, the device displays a second user interface (e.g., an application user interface, a settings user interface, or a home screen user interface). For example, in response to detecting the authorization input shown in FIG. **5**G, home screen user interface **522** is displayed in FIG. **5**H. While displaying the second user interface, the device detects an eleventh input for redisplaying the wake screen user interface **504** (e.g., detecting a downward swipe gesture on the touch-sensitive surface (e.g., a downward swipe gesture that started from the top edge of the touch-sensitive surface)). In response to detecting the eleventh input, the device ceases to display the second application user interface; and redisplays the wake screen user interface with the one or more notifications. For example, an input for redisplaying wake screen user interface **504** received while home screen user interface **522** is displayed is shown in FIGS. **5**I-**5**J. In some embodiments, in accordance with a determination that the authorization input is not valid, the second user interface is not displayed and/or the user is prompted for additional authorization input. In some embodiments, the authentication is automatically performed, and detecting an upward swipe gesture dismisses the wake screen user interface and reveals the last active user interface prior to the device's transition from the screen-on state to the screen-off state, or the last active user interface prior to the device's transition from the unlocked state to the locked state.

Maintaining display of a set of missed notifications after detecting intermediate inputs for dismissing and redisplaying a wake screen user interface makes the user-device

interface more efficient and enhances the operability of the device by allowing a user to display the wake screen repeatedly (e.g., to view the time or check for an incoming notification) while maintaining a list of missed notifications for the user to handle when the user is ready to interact with the notifications (without requiring the user to provide input for redisplaying the missed notifications while the wake screen is displayed).

In some embodiments, in accordance with the determination that the third input meets the notification-clearance criteria, the device adds (**640**), to a set of recent notifications, one or more cleared notifications that correspond to the at least one of the one or more notifications not displayed on the wake screen user interface. In some embodiments, when the notification-clearance criteria are met, all of the missed notifications are cleared from the wake screen user interface/cover sheet user interface, and are added to a list of recent notifications. In some embodiments, when a missed notification is individually cleared by direct user interaction with that notification, that notification is added to the list of recent notifications.

Adding a cleared notification to a set of recent notifications makes the cleared notification available for future user access. Making a cleared notification available for future user access makes the user-device interface more efficient by allowing a user to view notification content associated with multiple applications without individually accessing each application).

In some embodiments, after adding the one or more cleared notifications to the set of recent notifications, while the wake screen user interface is displayed, the device detects (**642**) a twelfth input (e.g., an upward swipe on the touch-screen that pulls on a currently displayed notification, or an input on a control for revealing recent notifications). In response to detecting the twelfth input, in accordance with a determination that the twelfth input meets recent-notification-display criteria, the device displays at least a portion of the set of recent notifications (e.g., overlaid on the wake screen user interface). For example, In FIGS. **5**BJ-**5**BO, notifications **506**-**512**, that were cleared as discussed with regard to **5**A-**5**AW, are redisplayed in response to an input that meets recent-notification-display criteria.

Displaying notifications from a set of recent notifications in response to input on the wake screen user interface allows a user to view a sequential list of notification content (e.g., including notifications that were previously cleared). Allowing a user to view a sequential list of notification content received by the device makes the user-device interface more efficient by allowing a user to view notification content associated with multiple applications without individually accessing each application).

It should be understood that the particular order in which the operations in FIGS. **6**A-**6**G have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **700**, **800**, and **900**) are also applicable in an analogous manner to method **600** described above with respect to FIGS. **6**A-**6**G. For example, the contacts, gestures, user interface objects, tactile outputs, focus selectors, and animations described above with reference to method **600** optionally have one or more of the characteristics of the contacts, gestures, user interface objects, tactile outputs, focus selectors, and animations described herein with reference to other methods described herein (e.g., methods **700**, **800**, and **900**). For brevity, these details are not repeated here.

The operations described above with reference to FIGS. **6**A-**6**G are, optionally, implemented by components depicted in FIGS. **1**A-**1**B. For example, receiving operation **602**, detection operation **604**, transitioning operation **606**, and displaying operation **606**, are, optionally, implemented by event sorter **170**, event recognizer **180**, and event handler **190**. Event monitor **171** in event sorter **170** detects a contact on touch-sensitive display **112**, and event dispatcher module **174** delivers the event information to application **136-1**. A respective event recognizer **180** of application **136-1** compares the event information to respective event definitions **186**, and determines whether a first contact at a first location on the touch-sensitive surface (or whether rotation of the device) corresponds to a predefined event or sub-event, such as selection of an object on a user interface, or rotation of the device from one orientation to another. When a respective predefined event or sub-event is detected, event recognizer **180** activates an event handler **190** associated with the detection of the event or sub-event. Event handler **190** optionally uses or calls data updater **176** or object updater **177** to update the application internal state **192**. In some embodiments, event handler **190** accesses a respective GUI updater **178** to update what is displayed by the application. Similarly, it would be clear to a person having ordinary skill in the art how other processes can be implemented based on the components depicted in FIGS. **1**A-**1**B.

FIGS. **7**A-**7**E are flow diagrams illustrating method **700** of displaying notification history in accordance with some embodiments. Method **700** is performed at an electronic device (e.g., device **300**, FIG. **3**, or portable multifunction device **100**, FIG. **1**A) with a display, a touch-sensitive surface, and one or more sensors to detect intensity of contacts with the touch-sensitive surface. In some embodiments, the display is a touch-screen display and the touch-sensitive surface is on or integrated with the display. In some embodiments, the display is separate from the touch-sensitive surface. Some operations in method **700** are, optionally, combined and/or the order of some operations is, optionally, changed.

As described below, method **700** provides an intuitive way to display a notification history. The method reduces the number, extent, and/or nature of the inputs from a user when displaying a notification history, thereby creating a more efficient human-machine interface. For battery-operated electronic devices, enabling a user to display a notification history faster and more efficiently conserves power and increases the time between battery charges.

The device displays (**702**), on display **112**, a first user interface, including displaying one or more missed notifications in a first scrollable arrangement (e.g., a first scrollable list) on the first user interface. For example, in FIG. **5**BA, notifications **586**, **588**, **590**, and **592** are displayed on wake screen user interface **504**. In some embodiments, the first user interface is a wake screen user interface **504** that is displayed upon the display transitioning from a display-off state to a display-on state (e.g., in response to detecting an input or event that wakes the device from the display-off state, such as a sleep state or other power-saving or inactive state). For example, FIGS. **5A1**-**5A4** show the display transitioning from a display-off state to a display-on state. In some embodiments, the first user interface is a cover sheet user interface (also depicted as **504**) that is displayed to cover a currently displayed user interface when a downward edge swipe gesture (e.g., a downward swipe that starts from

an upper edge of the touch-sensitive surface) is detected on the display. In some embodiments, the cover sheet user interface is also the wake screen user interface that is displayed when the device transitions from the screen-off state to the screen-on state.

While displaying the first user interface with the one or more missed notifications, the device detects (**704**) a first swipe gesture (e.g., as shown in FIGS. **5**BF-**5**BG), including detecting a first contact at a location on the touch-sensitive surface that corresponds to the first scrollable arrangement (e.g., as indicated by region **5100**), and detecting first movement of the first contact across the touch-sensitive surface in a first direction (e.g., upward).

In response to detecting the first swipe gesture, the device scrolls (**706**) the first scrollable arrangement in accordance with the first movement of the first contact (e.g., notifications **586**-**592** move upward in response to the input illustrated at FIGS. **5**BF-**5**BG).

After scrolling the first scrollable arrangement in accordance with the first movement of the first contact, the device detects (**708**) a second swipe gesture, including detecting a second contact at a location on the touch-sensitive surface that corresponds to the first scrollable arrangement and detecting second movement of the second contact across the touch-sensitive surface in the first direction (e.g., as shown in FIGS. **5**BI-**5**BN).

In response to detecting the second swipe gesture (**710**): in accordance with a determination that the second movement of the second contact meets notification-history-display criteria, the device displays a plurality of previously received notifications that are distinct from the one or more missed notifications in a second scrollable arrangement on the first user interface (e.g., the device displays previously received notifications **506**-**512**, which are distinct from missed notifications **586**-**592**). The notification-history-display criteria require (1) that the second movement of the second contact is detected after an end (e.g., a bottommost missed notification **5102**) of the first scrollable arrangement has been reached in accordance with the first movement of the first contact and (2) that the second movement exceeds a first threshold amount of movement (e.g., as indicated at **5108**) in the first direction. In accordance with the determination that the second movement of the first contact does not meet the notification-history-display criteria, the device forgoes displaying the plurality of previously received notifications (and, optionally, continuing to scroll the first scrollable arrangement in accordance with the second movement of the second contact).

This method relates to a way to combine the functions of a wake screen user interface and a notification history screen into a wake screen user interface. The wake screen user interface displays missed notifications, and in response to specific inputs notification history is displayed in the wake screen user interface as well. Displaying previously received notifications in accordance with a determination that movement of a contact meets notification history display criteria allows a user to view a sequential list notification content received by the device (e.g., including notifications that were previously cleared). The notifications in the second scrollable arrangement remain undisplayed when swipe input does not meet the notification-history-display criteria, so that the user does not unintentionally reveal previously cleared notifications. Allowing a user to view a sequential list of notification content received by the device makes the user-device interface more efficient by allowing a user to view notification content associated with multiple applications without individually accessing each application. Leaving the notifications in the second scrollable arrangement undisplayed when swipe input does not meet the notification-history-display criteria allows the user to navigate among the missed notifications in the first scrollable arrangement without unintentionally viewing previously cleared notifications.

In some embodiments (**712**), the first user interface is a wake screen user interface **504**, and the first user interface is displayed immediately upon waking the device from the display-off state to the display-on state. For example, FIGS. **5A1**-**5A4** show display of a wake screen user interface **504** when device **100** transitions from a display-off state to a display-on state.

In some embodiments, while displaying the one or more missed notifications in the first scrollable arrangement on the first user interface, the device detects (**714**) a missed notification dismissal input for dismissing a respective notification of the one or more missed notifications in the first scrollable arrangement. For example, input to dismiss notification **592** is illustrated in FIGS. **5**BV-**5**BY. A dismissal input for dismissing a respective notification is, e.g., an input to activate a displayed control (e.g., a tap gesture by a contact at a location that corresponds to the displayed control) for dismissing the notification; an input (such as a deep press or swipe gesture) on the notification to dismiss the notification, or to reveal a control for dismissing the notification followed by an input to activate a control for dismissing the notification, or an input to open the notification in an application (e.g., a tap gesture by a contact at a location that corresponds to the notification)). After detecting the missed notification dismissal input for dismissing the respective notification, the device ceases to display the respective notification of the one or more notifications on the first user interface, and adds the respective notification to the plurality of previously received notifications. For example, if the wake screen is displayed again without the respective notification, and a swipe gesture that meets notification-history-display criteria is detected on the first scroll arrangement including the remaining missed notifications, the respective notification is displayed among the plurality of previously received notifications in the second scrollable arrangement.

Ceasing to display a notification after detecting a missed notification dismissal input for dismissing the notification reduces the number of notifications displayed on the first user interface after the user has provided input that indicates the notification has been viewed and/or handled by the user. Reducing the number of notifications displayed on the first user interface makes the user-device interface more efficient by allowing a user to more quickly locate and address notifications that have not been previously viewed and/or handled by the user.

In some embodiments, while the first user interface is displayed, the device detects (**716**) a third swipe gesture (e.g., as shown at FIGS. **5**BB-**5**BC), including detecting a third contact at a location on the touch-sensitive surface that corresponds the first scrollable arrangement and detecting third movement of the third contact across the touch-sensitive surface in a second direction that is distinct from the first direction (e.g., downwards). In response to detecting the third swipe gesture, the device translates the first scrollable arrangement (and optionally, at least one object (e.g., an object that displays a current time and/or date)) in accordance with the third movement of the third contact (e.g., translating the first scrollable arrangement relative to other objects currently displayed on the first user interface in the downward direction, or translating the first user interface

as a whole in the downward direction to display an extension of the first user interface at the top that was not displayed prior to detecting the third swipe gesture). For example, notifications **586-592** move downward in accordance with the movement of the input shown in FIGS. **5**BB-**5**BC. The device detects lift-off of the third contact from the touch-sensitive surface (e.g., the touch-screen display) after detecting the third movement (e.g., the contact indicated by focus selector **594** in FIG. **5**BC has lifted off of touch screen **112**, as shown in FIG. **5**BD). In response to detecting the liftoff of the third contact, the device reverses the translation of the first scrollable arrangement that was made in accordance with the third movement of the third contact (e.g., restoring the position of the first scrollable arrangement relative to the other objects currently displayed on the first user interface, or restoring the first user interface as a whole and ceasing to display the extension of the first user interface at the top). As shown in FIGS. **5**BD-**5**BE, in response to the liftoff that occurred, the notifications move **586-592** upward.

Providing visual feedback, such as a "rubber band effect" simulated by translating the scrollable arrangement of missed notifications in accordance with movement of a contact and reversing the translation of the scrollable arrangement upon lift-off of the contact, enhances operability of the device by providing an intuitive indication to the user that the first user interface is responsive to input (such as a swipe input) to view additional notifications.

In some embodiments, while displaying the plurality of previously received notifications in the second scrollable arrangement on the first user interface, the device detects (**718**) a fourth swipe gesture (e.g., as shown at FIG. **5**CA), including detecting a fourth contact at a location on the touch-sensitive surface that corresponds to the second scrollable arrangement (e.g., notifications **506-512**) and detecting fourth movement of the fourth contact across the touch-sensitive surface in a second direction opposite the first direction (e.g., the fourth swipe gesture is a downward swipe gesture directed to the second scrollable arrangement). In response to detecting the fourth swipe gesture, in accordance with a determination that the fourth movement of the fourth contact meets notification-history-dismissal criteria, the device ceases to display the plurality of previously received notifications on the first user interface. In some embodiments, the notification-history-dismissal criteria require (1) that the fourth movement of the fourth contact is detected after an end (e.g., an uppermost notification) of the second scrollable arrangement has been reached and (2) that the fourth movement exceeds a second threshold amount of movement in the second direction opposite the first direction. In accordance with the determination that the fourth movement of the fourth contact does not meet the notification-history-dismissal criteria, the device scrolls the plurality of previously received notifications in the second scrollable arrangement in accordance with the fourth movement of the fourth contact. In some embodiments, scrolling the plurality of previously received notifications in the second scrollable arrangement causes at least one of the one or more missed notifications in the first scrollable arrangement to be revealed (e.g., if the at least one of the one or more missed notifications in the first scrollable arrangement was scrolled beyond the edge of the display in response to the first swipe gesture and/or the second swipe gesture). In some embodiments, scrolling previously received notifications causes missed notifications in the first scrollable arrangement to be revealed (e.g., as shown in FIGS. **5**BT-**5**BU), allowing a user to navigate between notifications that have been cleared and notifications that have not yet been cleared for a comprehensive view of notifications that have been received by the device. Providing the user with a comprehensive view of notifications that have been received by the device makes the user-device interface more efficient by allowing a user to view recent notification content without needing to individually access each application for which the content was received and/or generated.

Scrolling through the notification history or dismissing the notification history based on the same swipe gesture in accordance with whether the notification-history-dismissal criteria are met enhances the operability of the user interface and makes the user-device interface more efficient (e.g., by performing different functions based on whether predefined conditions are met), which additionally improves the battery life of the device.

In some embodiments, while displaying the first user interface, the device detects (**720**) a first user interface dismissal input for input (e.g., as shown at FIG. **5**CO) for dismissing the first user interface (e.g., a swipe gesture, including fifth movement of a fifth contact from a location that corresponds to an edge of the display (such as a location that is at or proximate to the bottom edge of the display) across the touch-sensitive surface in the first direction (e.g., upward from the bottom edge of the display). In response to detecting the first user interface dismissal input, the device ceases to display the first user interface (e.g., along with any missed notifications and/or recent notifications that are currently displayed on the first user interface), and, in some embodiments, the device reveals an underlying interface such as a home screen user interface **522**, a settings user interface, or an application user interface. For example, in FIGS. **5**CO-**5**CQ, home screen user interface **522** is revealed in response to an input for dismissing wake screen user interface **504**.

In some embodiments, the device includes one or more tactile output generators (**722**), and while the first user interface is displayed, in accordance with the determination that the second movement of the second contact meets the notification-history-display criteria (e.g., as described with regard to FIG. **5**BK), the device generates, with the one or more tactile output generators, a tactile output (e.g., tactile output **5112**) to indicate that the criteria for displaying the plurality of previously received notifications have been met.

Generating a tactile output to indicate that criteria for displaying the plurality of previously received notifications have been met provides the user with feedback about the input that is required to meet notification-history-display criteria. Providing the user with feedback about the input that is required to meet notification-history-display criteria makes the user-device interface more efficient (e.g., by helping the user to provide proper inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

In some embodiments (**724**), the first contact moves with a first rate of movement during the first swipe gesture, scrolling the first scrollable arrangement occurs at a first scroll rate that corresponds to the first rate of movement by the first contact (e.g., the scroll rate matches the first rate of movement); the second contact moves with a second rate of movement during the second swipe gesture; and displaying the plurality of previously received notifications in the second scrollable arrangement includes scrolling a first previously received notification of the plurality of previously received notifications in the second scrollable arrangement at a second scroll rate that is greater than the second

rate of movement by the second contact (e.g., to provide an appearance of the previously received notifications in the second scrollable arrangement "catching up" with the second contact). For example, as the contact indicated by focus selector **5106** moves along touch screen **112** as shown in FIGS. **5**BI-**5**BN, missed notifications **586-592** in a first scrollable arrangement move at the rate of movement of the contact, and, in FIGS. **5**BK-**5**BN, previously received notifications **506-512** in a second scrollable arrangement move faster than the rate of movement of the contact. In some embodiments, a second previously received notification of the plurality of previously received notifications is scrolled at a third scroll rate that is distinct from the second scroll rate.

Scrolling a first previously received notification of the plurality of previously received notifications in the second scrollable arrangement at a second scroll rate that is greater than the second rate of movement by the second contact provides the user with visual feedback about the input that is required to meet notification-history-display criteria (e.g., by giving the user of a sense of the notifications in the second scrollable arrangement "racing to catch up" with the second contact when the criteria are met). Providing the user with feedback about the input that is required to meet notification-history-display criteria makes the user-device interface more efficient (e.g., by helping the user to provide proper inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

In some embodiments, the device detects (**726**) a fifth swipe gesture, including detecting a fifth contact at a first location on the touch-sensitive surface and detecting fifth movement of the fifth contact across the touch-sensitive surface in a third direction that is perpendicular to the first direction (e.g., leftward or rightward). In response to detecting the fifth swipe gesture, in accordance with a determination that the first location on the touch-sensitive surface corresponds to a first notification among the one or more missed notifications or the plurality of previously received notifications, the device moves the first notification in accordance with the movement of the fifth contact (e.g., the input shown in FIG. **5**BV-**5**BW drags notification **592**). In accordance with a determination that the first location on the touch-sensitive surface corresponds to a location outside of the first scrollable arrangement and the second scrollable arrangement, the device replaces display of the first user interface with display of a second user interface (e.g., a control center user interface **5138** or mini application user interface **5140**). For example, FIGS. **5**CC-**5**CE illustrate a swipe gesture by contact at a location outside of the first scrollable arrangement and the second scrollable arrangement that causes control center user interface **5138** to be displayed, and FIGS. **5**CI-**5**CK illustrate a swipe gesture by contact at a location outside of the first scrollable arrangement and the second scrollable arrangement that causes mini application user interface **5140** to be displayed.

This heuristic allows a swipe gesture (e.g., a horizontal swipe gesture) to have different responses depending on whether the gesture corresponds to a missed notification or corresponds to a location outside of scrollable arrangements of missed notifications. This heuristic enhances operability of the device by providing different responses to the same gesture depending on the location of the gesture rather than requiring the device to provide a different gesture type (in turn requiring the user to learn the additional gesture type) to obtain the different responses.

In some embodiments, the device detects (**728**) that criteria for dismissing all of the one or more missed notifications in the first scrollable arrangement are met (e.g., via one or more inputs that include user interaction with all of the missed notifications, via one or more inputs for accessing one or more applications associated with the missed notifications, and/or by satisfying notification clearance criteria that require input that is received at a time that is (1) after a respective notification of the one or more notifications has been cleared through direct user interaction with the respective notification or an application that corresponds to the respective notification and (2) after the device has transitioned from the screen-on state to the screen-off state at least once since the last direct user interaction that dismissed a respective notification). In response to detecting that the criteria for dismissing all of the one or more missed notifications are met, the device adds, to the plurality of previously received notifications, all of the one or more missed notifications (and forgoing displaying those one or more missed notifications the next time that the first user interface is displayed). For example, in FIG. **5**CS, all notifications have been cleared (e.g., as a result of input as shown at FIGS. **5**BV-**5**BZ and FIGS. **5**CQ-**5**CS). In FIG. **5**CX, in response to input shown in **5**CW, notifications **586-592** that had been cleared and added to the plurality of previously received notifications are redisplayed.

In some embodiments, while displaying the first user interface without any missed notifications (e.g., after detecting that the criteria for dismissing all of the one or more missed notifications in the first scrollable arrangement have been met and adding the one or more missed notifications to the plurality of previously received notifications), the device detects (**730**) a sixth swipe gesture (e.g., as shown in FIG. **5**CW), including a sixth contact at a location on the touch-sensitive surface that corresponds to the location at which the first scrollable arrangement was previously displayed, and the device detects sixth movement of the sixth contact across the touch-sensitive surface in the first direction. In response to detecting the sixth swipe gesture: in accordance with a determination that the sixth movement of the sixth contact exceeds the first threshold amount of movement in the first direction, the device displays the plurality of previously received notifications (including the one or more missed notifications that were dismissed and added to the plurality of previously received notifications). For example, in FIG. **5**CX, in response to input shown in **5**CW, notifications **586-592** are redisplayed. In accordance with the determination that the sixth movement of the sixth contact does not exceed the first threshold amount of movement in the first direction, the device forgoes displaying the plurality of previously received notifications.

Displaying a plurality of previously received notifications after displaying the first user interface without any missed notifications allows a user to recall missed notifications (e.g., even after providing input to clear all missed notifications). Enabling the user to recall the missed notifications makes the user-device interface more efficient and by allowing the user to view content received and/or generated by the device without needing to access multiple applications. Additionally, a user can provide input to clear notifications with the knowledge that the notification will be recoverable if the user subsequently wishes to view the notification content.

In some embodiments, while the first user interface is displayed without any missed notifications (e.g., after

detecting that the criteria for dismissing all of the one or more missed notifications in the first scrollable arrangement have been met and adding the one or more missed notifications to the plurality of previously received notifications), the device detects (**732**) a seventh swipe gesture (e.g., as shown at FIGS. **5**CS-**5**CT), including detecting a seventh contact at a location on the touch-sensitive surface that corresponds to the location at which the first scrollable arrangement was previously displayed and detecting seventh movement of the seventh contact across the touch-sensitive surface in a second direction opposite the first direction (e.g., downward). In response to detecting the seventh swipe gesture, the device translates at least one object (e.g., an object **582** that displays a current time and/or date) displayed on the first user interface in the second direction in accordance with the seventh movement of the seventh contact. After translating the at least one object, the device detects lift-off of the seventh contact (e.g., as shown at FIG. **5**CU). In response to detecting liftoff of the seventh contact from the touch-sensitive surface, the device reverses the translation of the at least one object that have been made in accordance with the seventh movement of the seventh contact.

Providing visual feedback, such as a "rubber band effect" simulated by translating at least one object in accordance with movement of a contact and reversing the translation of the at least one object upon lift-off of the contact, enhances operability of the device by providing an intuitive indication to the user that the wake screen is responsive to input (such as a swipe input) to view notifications (e.g., even when the user is viewing a first user interface that does not include display of any missed notifications).

It should be understood that the particular order in which the operations in FIGS. **7**A-**7**E have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **600**, **800**, and **900**) are also applicable in an analogous manner to method **700** described above with respect to FIGS. **7**A-**7**E. For example, the contacts, gestures, user interface objects, tactile outputs, focus selectors, and animations described above with reference to method xxx optionally have one or more of the characteristics of the contacts, gestures, user interface objects, tactile outputs, focus selectors, and animations described herein with reference to other methods described herein (e.g., methods **600**, **800**, and **900**). For brevity, these details are not repeated here.

The operations described above with reference to FIGS. **7**A-**7**E are, optionally, implemented by components depicted in FIGS. **1**A-**1**B. For example, display operation **702**, detection operation **704**, and scrolling operation **706** are, optionally, implemented by event sorter **170**, event recognizer **180**, and event handler **190**. Event monitor **171** in event sorter **170** detects a contact on touch-sensitive display **112**, and event dispatcher module **174** delivers the event information to application **136-1**. A respective event recognizer **180** of application **136-1** compares the event information to respective event definitions **186**, and determines whether a first contact at a first location on the touch-sensitive surface (or whether rotation of the device) corresponds to a predefined event or sub-event, such as selection of an object on a user interface, or rotation of the device from one orientation to another. When a respective predefined event or sub-event is detected, event recognizer **180** activates an event handler **190** associated with the detection of the event or sub-event. Event handler **190** optionally uses or calls data updater **176** or object updater **177** to update the application internal state **192**. In some embodiments, event handler **190** accesses a respective GUI updater **178** to update what is displayed by the application. Similarly, it would be clear to a person having ordinary skill in the art how other processes can be implemented based on the components depicted in FIGS. **1**A-**1**B.

FIGS. **8**A-**8**C are flow diagrams illustrating method **800** of displaying updating information from an application using a floating banner in accordance with some embodiments. Method **800** is performed at an electronic device (e.g., device **300**, FIG. **3**, or portable multifunction device **100**, FIG. **1**A) with a display, a touch-sensitive surface, and one or more sensors to detect intensity of contacts with the touch-sensitive surface. In some embodiments, the display is a touch-screen display and the touch-sensitive surface is on or integrated with the display. In some embodiments, the display is separate from the touch-sensitive surface. Some operations in method **800** are, optionally, combined and/or the order of some operations is, optionally, changed.

As described below, method **800** provides an intuitive way to display updating information from an application in a floating banner. The method reduces the number, extent, and/or nature of the inputs from a user when accessing information that is displayed in the floating banner, thereby creating a more efficient human-machine interface. For battery-operated electronic devices, displaying updating information from an application in floating banner that is visible in various operating contexts allows the user to operate the device faster and more efficiently, which conserves power and increases the time between battery charges.

The device displays (**802**) a first user interface (e.g., an application user interface, a home screen user interface, a lock screen user interface, etc.) on the display. For example, in FIG. **5**DA, the device displays a map application user interface **5154**.

The device displays (**804**) a first user interface object overlaid on a first portion of the first user interface (e.g., the device displays a banner object, such as navigation banner **5160**, overlaid on a user interface of an application, such as map application user interface **5154**), where the banner object is initially stationary relative to the user interface of the application. In some embodiments, the first user interface object is displayed when a persistent banner display mode of an application is active. In some embodiments, persistent banner display modes include a navigation mode of a maps application, and the first user interface object is a banner that includes navigation information, such as text and/or an icon indicating information associated with a next step in a navigation sequence (e.g., navigation information includes navigation text **5178** and navigation direction image **5180**, as shown in FIG. **5**DT). In some embodiments, persistent banner display modes include a content playback mode of a media application, and the first user interface object is a banner that includes media playback information, such as text and/or an image that correspond to a playing content item and/or one or more playback controls (see, e.g., media banner **568** shown in FIG. **5**AO). In some embodiments, persistent banner display modes include a telephone call session of a telephone application, and the first user interface object is a banner that includes text with information about the call in progress, such as elapsed time and/or

contact information. In some embodiments, the first user interface object is a notification.

While displaying the first user interface object overlaid on the first portion of the first user interface, the device detects (**806**) a first input (e.g., a downward swipe input from an upper edge of the display **112**, as shown at FIG. **5**DB) for displaying a cover sheet user interface **504**. In some embodiments, the cover sheet user interface **504** is also a wake screen user interface that is displayed when the device transitions from a screen-off state to a screen-on state. The cover sheet user interface **504** includes a first content object (e.g., one or more missed notifications, such as missed notifications **5164** and **5168** shown in FIG. **5**DD) and a second content object (e.g., a time-date object **582** that displays a current time and date) displayed on a background object (e.g., a cover sheet platter or substrate with a predefined background).

In response to detecting the first input for displaying the cover sheet user interface **504**, the device moves (**808**) the cover sheet user interface **504** across the display in a first direction (e.g., downward). For example, cover sheet user interface **504** slides down over map application user interface **5154**, as shown at FIGS. **5**DC-**5**DD. Moving the cover sheet user interface **504** across the display in a first direction includes moving the background object **5163** of the cover sheet user interface **504** across the display (e.g., to obscure an increasing portion of the first user interface without obscuring the first user interface object that is overlaid on the first user interface). In some embodiments, the background object **5163** of the cover sheet user interface slides onto the display in a z-layer that is located between the z-layer of the first user interface and the z-layer of the first user interface object.

Many electronic devices display user interface objects that have a layer order (i.e., a z-order or front-to-back order of the user interface objects). A user typically interacts with such objects by repositioning them on the display, and overlapping objects are displayed on the display in accordance with their front-to-back order (e.g., an object that is "in front" of another object is displayed where the two objects overlap). As used in the specification, a "layer order" is the front-to-back order of objects in a user interface (e.g., in an electronic document). Thus, if two objects overlap, the object that is higher in the layer order (e.g., the object that is "on top of" or "in front of") is displayed at any points where the two objects overlap, thereby partially obscuring the object that is lower in the layer order (e.g., the object that is "beneath" or "behind" or "in back of" the other object).

In accordance with a determination that the first user interface object has not reached a predefined threshold position relative to the cover sheet user interface (e.g., relative to a position between the first content object (e.g., missed notifications **5164** and/or **5168**) and the second content object (e.g., time/date object **582**) in the cover sheet user interface **504**), the device moves the first content object and the second content object (e.g., in unison) with the background object **5163** while maintaining a current position of the first user interface object (e.g., navigation banner **5160**) on the display (e.g., as shown in FIGS. **5**DC-**5**DD). In accordance with a determination that the first user interface object (e.g., navigation banner **5160**) has reached the predefined threshold position relative to the cover sheet user interface, the device moves the first user interface object (e.g., in unison) with the background object (e.g., as shown in FIGS. **5**DD-**5**DE). In some embodiments, the device also moves the first content object (e.g., missed notifications **5164** and **5168**), the second content object (e.g., time/date object **582**), and the first user interface object (e.g., navigation banner **5160**) in unison with the background object **5163**. For example, in FIG. **5**DD, the time/date object **582** catches the banner object **5160** on its way down and pushes the banner object downward with the time/date object.

Method **800** relates to combining display of a user interface object that is overlaid on an initial user interface (e.g., a home screen user interface) with a newly displayed user interface (e.g., a cover sheet user interface). Specifically, some of the objects on the newly displayed user interface move past the first user interface object, while other objects on the newly displayed user interface "catches" the first user interface object and pushes it to its final position on the newly displayed user interface. This heuristic brings attention to the first user interface object (e.g., a banner object) by moving or not moving the first user interface object with the background object depending on whether the first user interface object has reached a predefined threshold position relative to a cover sheet interface. Bringing attention to the first user interface object improves the user-device interface, e.g., by helping the user to understand the connection between the banner content and the application from which the banner content originated. Displaying the banner improves the operability of the device by allowing the user to view content from an application without needing to navigate to the application, reducing the number of inputs required from the user to obtain banner content (e.g., navigation information).

In some embodiments, moving the cover sheet user interface **504** across the display in the first direction includes (**810**), in accordance with a determination that the second content object (e.g., the time and date object **582**) has reached a first predefined location (e.g., the default position for the time and date on the display when the cover sheet is fully displayed) on the display, ceasing to move the second content object (e.g., the time and date **582**) and the first user interface object (e.g., the banner **5160**) and continuing to move the first content object (the one or more missed notifications) in the first direction (e.g., to make room for the banner object **5160** between the top missed notifications (e.g., notifications **5164** and **5168**) and the current time and date object **582**. For example, as cover sheet user interface **504** slides down in FIGS. **5**DC-**5**DF, time/date object **582** and the navigation banner **5160** stop moving in FIG. **5**DE, while missed notifications **5164** and **5168** continue to move downward in FIGS. **5**DE-**5**DF.

Ceasing to move some of the content object while continuing to move other content objects on the cover sheet user interface allows the cover sheet user interface to be rearranged to accommodate the first user interface object (e.g., the banner), while providing visual continuity to the user, thereby reducing user mistakes when operating the device and enhance the operability of the device.

In some embodiments, the device ceases (**812**) to continue to move the first content object (e.g., the one or more missed notifications) in the first direction in accordance with a determination that the first content object has reached a second predefined location on the display (e.g., ceasing to move the missed notifications once the missed notifications have completely moved past the banner object).

Continuing to move the content objects on the cover sheet user interface until they reach their final locations allows the cover sheet user interface to be rearranged to accommodate the first user interface object (e.g., the banner), while providing visual continuity to the user, thereby reducing user mistakes when operating the device and enhance the operability of the device.

In some embodiments, the device transitions (**814**) from a screen-on state (as shown in FIG. **5**DY) to a screen-off state (as shown in FIG. **5**DZ) in accordance with a determination that display shutoff criteria are met (e.g., a power button is pressed or a period of user inactivity is detected). While the display is in the screen-off state, the device displays the first user interface object (e.g., the banner **5160**) on a dark screen corresponding to the screen-off state (e.g., in accordance with a determination that an application associated with the first user interface object is in a persistent banner display mode, such as a navigation mode of a map application, a playback mode of a media application, or a call mode of a phone application). For example, in FIG. **5**DZ, navigation banner **5160** is displayed on an otherwise dark display **112**.

Displaying a first user interface object (e.g., a banner) when the device is in a screen-off state (e.g., displaying the first user interface object on an otherwise dark screen or on a screen that displays only one or more received notifications in addition to the first user interface object) provides the user with high priority information (e.g., navigation information) while the display forgoes displaying other content. Displaying the first user interface object (and/or the one or more missed notifications) while forgoing display of other content makes the user-device interface more efficient by reducing the amount of power required for the display. Additionally, displaying the first user interface object (and/or the one or more missed notifications) while forgoing display of other content eliminates the need for the user to wake the display from a screen-off state to display the first user interface object.

In some embodiments, while the display is in the screen-off state and the first user interface object is displayed on the display, the device receives (**816**) one or more notifications and, in response to receiving the one or more notifications, the device displays the first user interface object (e.g., the banner) and a third content object (e.g., the one or more notifications) on the first user interface (e.g., the one or more missed notifications are displayed under the first user interface object). For example, in FIG. **5**EA, the device displays banner **5160** and missed notification **5186** on otherwise dark display **112**. In some embodiments, while the display is in the screen-off state, the device detects a notification event and displays a notification object (e.g., for a new notification) under the banner. In some embodiments, one or more previously received notifications are displayed on the display (e.g., under the banner and/or above the new notification) while the display is in the screen-off state.

Displaying one or more received notifications when the device is in a screen-off state (e.g., displaying the one or more received notifications on an otherwise dark screen or on a screen that displays only a first user interface object in addition to the one or more received notifications) provides the user with high priority information (e.g., navigation information) while the display forgoes displaying other content. Displaying the one or more received notifications (and/or the first user interface object) while forgoing display of other content makes the user-device interface more efficient by reducing the amount of power required for the display. Additionally, displaying the one or more missed notifications (and/or the first user interface object) while forgoing display of other content eliminates the need for the user to wake the display from a screen-off state to display the one or more missed notifications.

In some embodiments, the device transitions (**818**) the device from a screen-off state to a screen-on state (e.g., as shown in FIGS. **5A1**-**5A3** and **5**EA-**5**EB) in accordance with a determination that display-waking criteria are met (e.g., a power button is pressed or the device orientation is changed in a certain way (e.g., picked up by a user), or a notification event is detected). In response to transitioning the device from the screen-off state to the screen-on state, the device displays the first user interface object (and no other objects) on a dark screen that corresponds to the display-off state. For example, in FIG. **5**DZ, navigation banner **5160** is displayed on an otherwise dark display **112**.

Displaying a first user interface object (e.g., a banner) when the device is in a screen-off state (e.g., displaying the first user interface object on an otherwise dark screen or on a screen that displays only one or more received notifications in addition to the first user interface object) provides the user with high priority information (e.g., navigation information) while the display forgoes displaying other content. Displaying the first user interface object (and/or the one or more missed notifications) while forgoing display of other content makes the user-device interface more efficient by reducing the amount of power required for the display. Additionally, displaying the first user interface object (and/or the one or more missed notifications) while forgoing display of other content eliminates the need for the user to wake the display from a screen-off state to display the first user interface object.

In some embodiments, while the cover sheet interface is displayed, the device detects (**820**) a third input (e.g., as shown at FIGS. **5**DQ-**5**DR) for dismissing the cover sheet user interface **504**. The third input includes a swipe gesture by a contact on the touch-sensitive surface (e.g., a upward swipe that started from the bottom edge of the touch-screen). In response to detecting the third input for dismissing the cover sheet user interface, the device ceases to display the cover sheet user interface **504**, maintains display of the first user interface object (e.g., navigation banner **5160**), and displays a home screen user interface **522**. The first user interface object is overlaid on the home screen user interface. For example, in response to detecting an upward swipe gesture from the bottom edge of the touch-screen (e.g., as shown in FIGS. **5**DQ-**5**DR), the cover sheet user interface **504** slides upward to reveal the home screen interface **522** underneath, while the first user interface (e.g., navigation banner **5160**) remains stationary in a display layer above the cover sheet user interface **504**, and appears overlaid on the home screen user interface **522** after the cover sheet user interface **504** is completely removed from view. In some embodiments, instead of the home screen user interface **522**, a user interface of an application is displayed when the input for dismissing the cover sheet user interface **504** is detected, and the first user interface object is overlaid on the user interface of the application.

Displaying the first user interface object (e.g., a banner, such as navigation banner **5160**) overlaid on the home screen makes the user-device interface more efficient by allowing the user to view the first user interface object after accessing the home screen without needing to navigate from the home screen to the application that generated the content of the first user interface object.

In some embodiments, while displaying the first user interface object overlaid on the home screen user interface (or a user interface of an application), the device detects (**822**) an input for minimizing the first user interface object (e.g., a upward swipe gesture on the banner, as shown at FIG. **5**DT). In response to detecting the input for minimizing the first user interface object, the device transitions the first user interface object (e.g., banner mode of navigation banner **5160**, as shown in FIG. **5**DT) into a second user interface

object (e.g., a "pill" that has a smaller area than the first user interface object, as shown at **5160** FIG. **5**DW). The first user interface object has a first size and the second user interface object has a second size that is smaller than the first size. In some embodiments, the second user interface object pulsates or blinks (e.g., at least a portion of the pill, such as the background of the pill, periodically changes color and/or size over time) to indicate that an application mode or process associated with the banner object is still active. In some embodiments, the second user interface object displays at least a portion of information displayed by the first user interface object. For example, in FIG. **5**DT, navigation banner **5160** in banner mode displays navigation direction arrow **5180**, which is also displayed in the pill mode of navigation banner **5160** in FIG. **5**DW. In some embodiments, the device displays an animated transition showing the banner shrinking and morphing into the "pill" while moving and settling into a upper corner of the touch-screen (e.g., as shown at FIGS. **5**DT-**5**DW). In some embodiments, the second user interface object (e.g., navigation banner **5160** in pill form) displays media playback information (e.g., a play/pause toggle control). In some embodiments, the second user interface object displays information (e.g., a turn icon) associated with a navigation instruction.

Transitioning the first user interface object into a second user interface object in response to detecting input for minimizing the first user interface object makes the user-device interface more efficient by allowing the user to simultaneously view content of the home screen user interface that would otherwise be covered by the first user interface object and information from the first user interface object that is contained in the second user interface object (e.g., without needing to navigate from the home screen to the application that generated the content of the first user interface object).

In some embodiments, while the second user interface object is displayed, the device determines (**824**) that the display shutoff criteria are met. In response to determining that the display shutoff criteria are met, the device transitions the device from the screen-on state to a screen-off state, transitions the second user interface object into the first user interface object; and displays the first user interface object overlaid a dark screen corresponding to the screen-off state (e.g., a direct transition from FIG. **5**DX to FIG. **5**DZ).

Transitioning the second user interface object into a first user interface object in response to determining that display shutoff criteria are met provides the user with a larger object for increased visibility when the device is likely to be distant from the user (e.g., on a table or in a car rather than in the user's hand). Providing the user with a larger object for increased visibility reduces power usage and improves battery life by providing information without requiring the user to wake the device and/or navigate to an application that generated the content of the first user interface object.

In some embodiments, while the second user interface object is displayed, the device detects (**826**) an input for activating the second user interface object (e.g., a tap input on the second user interface object). For example, in FIG. **5**DX, an input is detected at a location corresponding to navigation banner **5160** in pill form, as indicated by focus selector **5160** in FIG. **5**DX. In response to detecting the input for activating the second user interface object, the device displays an application user interface of an application that corresponds to the second user interface object. For example, in response to the input described with regard to FIG. **5**DX, map application **5154** is displayed, as shown in FIG. **5**DY.

Displaying an application user interface of an application that corresponds to the second user interface object in response to detecting input for activating the second user interface object provides the user with direct access to an application that corresponds to the second user interface object (e.g., the user can access the application that corresponds to the second user interface object from any page of a multi-page home screen without needing to provide input to navigate to an application launch icon on a different page of the home screen, within a folder on the home screen, etc.). This makes the user-device interface more efficient and enhances the operability of the device by reducing the number of inputs required to access an application user interface of an application that corresponds to the second user interface object.

In some embodiments, while the first user interface object is displayed (e.g., overlaid over the first user interface or overlaid over the cover sheet user interface **504**), the device detects (**828**) an input that activates the first user interface object (e.g., a tap input on the first user interface object). For example, in FIG. **5**DH, an input, as indicated by focus selector **5168**, is detected at a location that corresponds to the navigation object **5160** displayed overlaid over cover sheet user interface **504**. In response to detecting the input that activates the first user interface object, the device displays the application user interface of the application that corresponds to the information displayed in the first user interface object. For example, in response to the input, maps application **5154** is displayed, as shown in FIG. **5**DI.

In some embodiments, the application that corresponds to the second user interface object is an application that also corresponds to the first user interface object.

Displaying an application user interface of an application that corresponds to the first user interface object in response to detecting input for activating the first user interface object provides the user with direct access to an application that corresponds to the first user interface object (e.g., the user can access the application that corresponds to the first user interface object directly from the first user interface or the cover sheet user interface without providing input to navigate to the home screen.) This makes the user-device interface more efficient and enhances the operability of the device by reducing the number of inputs required to access an application user interface of an application that corresponds to the first user interface object.

It should be understood that the particular order in which the operations in FIGS. **8**A-**8**C have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., **600**, **700**, and **900**) are also applicable in an analogous manner to method **800** described above with respect to FIGS. **8**A-**8**C. For example, the contacts, gestures, user interface objects, focus selectors, animations described above with reference to method xxx optionally have one or more of the characteristics of the contacts, gestures, user interface objects, focus selectors, animations described herein with reference to other methods described herein (e.g., methods **600**, **700**, and **900**). For brevity, these details are not repeated here.

The operations described above with reference to FIGS. **8**A-**8**C are, optionally, implemented by components depicted in FIGS. **1**A-**1**B. For example, display operation **802**, detection operation **806**, and object moving operation

808 are, optionally, implemented by event sorter **170**, event recognizer **180**, and event handler **190**. Event monitor **171** in event sorter **170** detects a contact on touch-sensitive display **112**, and event dispatcher module **174** delivers the event information to application **136-1**. A respective event recognizer **180** of application **136-1** compares the event information to respective event definitions **186**, and determines whether a first contact at a first location on the touch-sensitive surface (or whether rotation of the device) corresponds to a predefined event or sub-event, such as selection of an object on a user interface, or rotation of the device from one orientation to another. When a respective predefined event or sub-event is detected, event recognizer **180** activates an event handler **190** associated with the detection of the event or sub-event. Event handler **190** optionally uses or calls data updater **176** or object updater **177** to update the application internal state **192**. In some embodiments, event handler **190** accesses a respective GUI updater **178** to update what is displayed by the application. Similarly, it would be clear to a person having ordinary skill in the art how other processes can be implemented based on the components depicted in FIGS. **1**A-**1**B.

FIGS. **9**A-**9**C are flow diagrams illustrating method **900** of navigation using a cover sheet, in accordance with some embodiments. Method **900** is performed at an electronic device (e.g., device **300**, FIG. **3**, or portable multifunction device **100**, FIG. **1**A) with a display, a touch-sensitive surface, and one or more sensors to detect intensity of contacts with the touch-sensitive surface. In some embodiments, the display is a touch-screen display and the touch-sensitive surface is on or integrated with the display. In some embodiments, the display is separate from the touch-sensitive surface. Some operations in method **800** are, optionally, combined and/or the order of some operations is, optionally, changed.

As described below, method **900** provides an intuitive way to navigate using a cover sheet. The method reduces the number, extent, and/or nature of the inputs from a user for accessing various controls that are available from user interfaces that are accessible via input provided at the cover sheet, thereby creating a more efficient human-machine interface. For battery-operated electronic devices, enabling a user to navigate using a cover sheet faster and more efficiently conserves power and increases the time between battery charges.

While the device is in a screen-off state, the device detects (**902**) a first input for waking the device from the screen-off state to a screen-on state (e.g., the device detects a state change indicating that the device has been picked up, as described with regard to FIGS. **5**EC**1**-**5**EC**4**, or the device detects an input at a control, such as push button **106**, for waking the device).

In response to detecting the first input for waking the device from the screen-off state to the screen-on state, the device transitions (**904**) the device from the screen-off state to the screen-on state (e.g., as shown at FIGS. **5**EC**2**-**5**EC**3**), and displays a wake screen user interface **504** on the display **112**. In some embodiments, the wake screen user interface **504** is redisplayed as a cover sheet user interface that covers an existing user interface in response to a cover sheet call-up command, and re-reveals the existing user interface that was covered by the cover sheet user interface in response to a cover-sheet dismissal command.

While displaying the wake screen user interface, the device detects (**906**) a first swipe gesture on the touch-sensitive surface **112** (e.g., a swipe gesture as shown at FIGS. **5**EK-**5**EL or a swipe gesture as shown at FIGS. **5**EQ-**5**ER), including detecting a first contact on the touch-sensitive surface and detecting movement of the first contact across the touch-sensitive surface.

In response to detecting the first swipe gesture, the device (**908**) ceases to display the wake screen user interface **504** and displays a first user interface. In accordance with a determination that the first swipe gesture is in a first direction (e.g., rightward, as shown in FIGS. **5**EK-**5**EL), the displayed first user interface is a mini-application-object user interface **5140**. The mini-application-object user interface **5140** includes one or more mini-application objects (e.g., mini-application objects **583**, **585**, **587**, and **589**) that each provide a subset of functions of a corresponding application without launching the corresponding application. In accordance with a determination that the first swipe gesture is in a second direction (e.g., leftward, as shown in FIGS. **5**EQ-**5**ER), that is opposite the first direction, the displayed first user interface is a control panel user interface **5138**. The control panel user interface **5138** includes one or more device controls (e.g., flashlight control **5190** and camera control **5192**) for controlling one or more device functions of the device.

The wake screen user interface **504** has a fixed positional relationship relative to the mini-application-object screen **5140** and the control panel user interface **5138**. Allowing the user to use directional gestures to navigate to either the mini-application-object screen or the control panel user interface enhances the operability of the device (e.g., by reducing the number of controls displayed on a wake screen user interface) and makes the user-device interface more efficient (e.g., by reducing visual clutter and reducing user mistakes due to the visual clutter), which, additionally, improves the battery life of the device.

In some embodiments, while the wake screen user interface **504** is displayed, the device displays (**910**) one or more notifications (e.g., notification **5188**, as shown in FIG. **5**ED) on the wake screen user interface. The device detects a second input for transitioning the device from an unauthenticated state to an authenticated state (e.g., as described with regard to FIGS. **5**FN-**5**FQ). In response to detecting the second input, the device displays, on the wake screen user interface **504**, restricted notification information corresponding to at least one of the one or more notifications. For example, as shown in FIG. **5**FT, an additional notification **5234** is displayed and notification **5188** displays text **5234** and image **5236** that were not displayed prior to authentication. In some embodiments, restricted notification information is, e.g., notification content and/or other notification information that is subject to restricted access by a setting, such as a privacy and/or security setting of the device. In some embodiments, the restricted notification information includes one or more notifications that are not displayed when the device is an unauthenticated state, such as notifications from one or more applications with settings that restrict display of notifications when the device is in an unauthenticated state. In some embodiments, the restricted notification information includes contextual information, such as earlier communication content in a notification and/or calendar information for a range of time that corresponds to a time associated with a calendar appointment notification. In some embodiments, when the device is in the unlocked mode of the display-on state, the second user interface includes longer versions of the notifications that are shown in the second user interface when the device is in the locked mode of the display-on state. The longer version of a notification includes expanded notification content that, for example, includes all of the content in the short version

or standard version of the notification, and some additional content that is not included in the short version or standard version of the notification. In some embodiments, the expanded notification content includes more complete versions of the notification content shown in the short version of the notification. In some embodiments, the expanded notification content includes images, interactive controls, and/or selectable options for performing actions with respect to the notification, that are not included in the short versions of the notification.

Displaying restricted notification information in response to detecting a second input for transitioning the device from an unauthenticated state to an authenticated state allows the device to provide a user with an indication that a notification was received without disclosing full notification information to unauthenticated individuals able to view the device display. This makes the user-device interface more efficient and enhances the operability of the device by allowing a user to view information about incoming notifications without needing to wake the device (e.g., without jeopardizing the privacy of the notification content).

In some embodiments, while displaying the first user interface in response to the first swipe gesture, the device detects (**912**) a second swipe gesture (e.g., as shown in FIG. **5**FN and or as shown in FIG. **5**GC) in a third direction (e.g., upward, such as upward from a location proximate to the lower edge of the display) that is perpendicular to the first direction and the second direction. In accordance with a determination that the device is in an unauthenticated state, the device displays an authentication user interface **518**, as shown at FIG. **5**FO. In accordance with a determination that the device is in an authenticated state, the device displays a second user interface. The second user interface is a last displayed user interface that was displayed prior to the display of the wake screen user interface (e.g., either a home screen user interface or a user interface of an application). For example, FIG. **5**GC is displayed when home screen user interface **522** was the last displayed user interface before wake screen user interface **504** was displayed, so in response to the swipe input illustrated at FIG. **5**GC, home screen user interface **522** is redisplayed, as shown in FIG. **5**GD. In some embodiments if the home screen user interface **522** was the last displayed user interface before the wake screen user interface **504** was displayed, then a swipe up from the control center user interface **5138** or mini application user interface **5140** reveals the home screen user interface **522** and if an application user interface (e.g., map application user interface **5154**) was the last displayed user interface before the wake screen user interface **504** was displayed, then the swipe up reveals the application user interface. In some embodiments, the wake screen user interface **504** is displayed immediately upon waking the device, before authentication is made, and when authentication fails. In some embodiments, an indicator (e.g., an open lock icon and/or text indicating an unlocked state) is displayed briefly on the wake screen upon authentication. In some embodiments, an indicator changes state (e.g., a lock icon changes state from a closed lock icon to an open lock icon) in accordance with a determination that authentication has been successfully performed.

Redisplaying a last displayed user interface after dismissing the first user interface (e.g., the wake screen user interface/cover sheet user interface) enhances the operability of the device by reducing the number of steps needed to navigate back to the previous user interface, and the consistent behavior also reduces user mistakes which makes the user-device interface more efficient.

In some embodiments, in accordance with a determination that the second user interface is a home screen user interface **522**, the device displays (**914**), in the home screen user interface, an object (e.g., navigation banner **5160**) that displays content from a first active application (e.g., an application that has updating content, such as an application that last had focus and includes updating content, or an application that has a highest priority among multiple applications that includes updating content). In accordance with a determination that a state of the first active application has changed, the device updates the content displayed in the object in accordance with the changed state of the first active application. For example, navigation content shown in navigation object **5160** (shown in pill form in FIGS. **5**GM and **5**GU) updates (e.g., in accordance with a determined change in location of the device). In some embodiments, navigation content shown in navigation object **5160** (shown in banner form in FIGS. **5**GP-**5**GQ) updates (e.g., in accordance with a determined change in location of the device). In some embodiments, the object also includes a region **5182** that displays a current time. In some embodiments, the object on the home screen user interface **522** is a "pill" (e.g., an object having a pill shape). In some embodiments, the object on the home screen user interface **522** is displayed in a region of the device display that is beyond a main display area (e.g., a rectangular display area) of the display. In some embodiments, the object displays live directions from a maps application operating in navigation mode. In some embodiments, the object displays live playback information from a media player application operating in playback mode. In some embodiments, the object displays live recording information from a screen recording or video recording application operating in recording mode. In some embodiments, the object corresponding to the first active application is also displayed when a user interface of a second active application distinct from the first active application is the currently displayed user interface.

Updating the content displayed in an object in the home screen user interface in accordance with a changed state of an active application provides information to a user from an active application without displaying the full application user interface. This makes the user-device interface more efficient by allowing a user to determine that an application is operating in an active mode without providing input to navigate from the home screen to the application user interface.

In some embodiments, while displaying the second user interface in response to the second swipe gesture, the device detects (**916**) a third swipe gesture (e.g., as shown at FIG. **5**FR) in a fourth direction (e.g., downward) that is opposite the third direction; and in response to detecting the third swipe gesture in the fourth direction, the device ceases to display the second user interface (e.g., home screen user interface **522**) and redisplays the wake screen user interface **504** (e.g., as shown in FIGS. **5**FR-**5**FT).

In some embodiments, the control center user interface **5138** is displayed in response to a left swipe on the wake screen user interface **504** (e.g., as shown at FIGS. **5**EQ-**5**ES) both when the wake screen user interface **504** is first displayed on waking the device, and when the wake screen user interface **504** is subsequently redisplayed (e.g., as a cover sheet layer over an application user interface or over a home screen user interface). In some embodiments, the mini-application-object user interface **5140** is displayed in response to a right swipe on the wake screen user interface **504** (e.g., as shown at FIGS. **5**EK-**5**EM) both when the wake screen user interface **504** is first displayed, and when the

wake screen user interface **504** is subsequently redisplayed. In some embodiments, as the third swipe gesture in the fourth direction is received, the object on the home screen (the "pill") morphs into a second affordance (a floating banner) that is displayed on the wake screen user interface **504** (e.g., as shown by navigation banner **5160** in FIGS. **5**GM-**5**GP). The morphing includes, e.g., a change in the size of the object, addition of content to the object (e.g., a direction icon **5180** and/or text), and/or removal of content (e.g., a time **5182**) from the object.

Redisplaying the first user interface from any user interface (e.g., the home screen user interface or an application user interface) using the same gesture enhances the operability of the device (e.g., by reducing the number of steps needed to navigate to the first user interface), and makes the user-device interface more efficient (e.g., by providing a consistent way to bring about the first user interface and thereby reducing user mistakes).

In some embodiments, the wake screen user interface is displayed (**918**) with an affordance (e.g., a navigation banner **5160**) that displays content from a second active application (e.g., an application, that is the same as the first active application or distinct from the first active application, that has updating content (such as an application that last had focus and includes updating content, or an application that has a highest priority among multiple applications that includes updating content)). For example, navigation banner **5160** shown in FIG. **5**GP-**5**GQ includes updating content from maps application **5154**. While displaying the wake screen user interface **504** with the affordance, in accordance with a determination that a state of the second active application has changed (e.g., a location of the device has changed, requiring an updated navigation instruction), the device updates the content displayed in the affordance in accordance with the changed state of the second active application (as indicated by the changed content from FIG. **5**GP to FIG. **5**GQ). For example, an affordance that corresponds to a maps application includes navigation information (such as next turn information) that updates in real time, or an affordance that corresponds to a media player includes media playback information that updates in real time. In some embodiments, the wake screen user interface **504** includes an intelligently selected app icon, e.g., a hand-off application. In some embodiments, the first affordance is displayed in addition to one or more additional objects on the wake screen (e.g., in addition to time indicator, notification affordances, and/or device control affordances). In some embodiments, the content from the active application displayed in the object (e.g., the pill object) on the home screen user interface is a miniaturized version of the content displayed in the first affordance on the wake screen user interface. For example, in comparison with content displayed in the first affordance on the wake screen, a miniaturized version of the content includes a reduced amount of text, text with reduced size, no text, a reduced number of icons, icons with reduced size, and/or no icons. In some embodiments, content displayed in the first affordance on the wake screen includes navigation instruction text and a navigation instruction icon having a first size, and the miniaturized version of the content includes no navigation instruction text and a navigation instruction icon having a second size that is smaller than the first size.

Updating the content displayed in the affordance displayed in the wake screen user interface in accordance with a changed state of an active application provides information to a user from an active application without displaying the full application user interface. This makes the user-device interface more efficient by allowing a user to receive information from the application without providing input to navigate from the wake screen user interface to the application user interface.

In some embodiments, the wake screen user interface **504** includes (**920**) a first control (e.g., flashlight control **5190** and/or camera control **5192**) of the one or more device controls of the control panel user interface **5138** (e.g., as shown in FIG. **5**ED and **5**EW). In some embodiments, the first control is, e.g., a flashlight control **5190** that corresponds to the flashlight control **5190** of the control panel user interface **5138**. When operated, the flashlight control operates a device flashlight. In some embodiments, the affordance is, a camera control **5192** or another pre-selected (e.g., user-selected) control. In some embodiments, the wake screen user interface **504** includes one or more regions (e.g., lower left and lower right corners) that display affordances for pre-selected apps (e.g., a flashlight control icon **5190** and/or a camera application control icon **5192**). In some embodiments, the wake screen user interface **504** includes at least one control affordance that does not correspond to a device control of the control panel user interface.

Providing controls from the control panel user interface on the wake screen user interface allows the user to access the same control functions from multiple locations, and thereby making the user-device interface more efficient (e.g., by reducing the number of steps needed to navigate to the control).

In some embodiments, the first control requires (**922**) a first type of input to activate a first function while displayed on the wake screen user interface and the first control requires a second type of input to activate the first function while displayed on the control panel user interface. In some embodiments, the first control requires different inputs for activating the same function (e.g., a press input is required to toggle the flashlight control **5190** on the wake screen user interface **504**, as described with regard to FIGS. **5**ED-**5**EJ, while a tap input is required to toggle the flashlight control **5190** in the control panel user interface **5138**, as described with regard to FIGS. **5**ES-**5**EW. In some embodiments, a plurality of pre-selected affordances are displayed on the wake screen. In some embodiments, the pre-selected affordances on the wake screen are user-customizable.

Requiring a different input to activate a function from the wake screen than the input that is required to activate the same function from the control center prevents accidental operation of the function (e.g., operation of the flashlight) when the phone wakes at a time that the user does not intend to operate the phone. This saves battery life (e.g., by not using battery to operate the flashlight when the flashlight is not needed).

In some embodiments, the first control (e.g., camera control **5192**) is also displayed on the home screen user interface **522** (**924**), and a press input directed to the first control while displayed on the home screen user interface causes display of a plurality of selectable options (e.g., as shown in menu **5220**), and a press input directed to the first control while displayed on the wake screen user interface does not cause display of the plurality of selectable options.

Displaying a plurality of selectable options in response to press input at control displayed on the home screen user interface and not displaying the plurality of selectable options when a press input is received at the same control displayed on the wake screen user interface prevents accidental access to functions among the plurality of selectable options (e.g., taking a photo) when the phone wakes at a time that the user does not intend to operate the phone. This saves

battery life (e.g., by not using battery to operate the camera when the camera is not needed).

In some embodiments, the wake screen has a plurality of luminosity display modes (e.g., bright mode, as shown in FIG. **5**GV, and dark mode, as shown in FIG. **5**GW) that are applied to one or more objects (e.g., notifications **5160**, **5188**, **5234**, and other platters and/or banners, such as navigation banner **5160**) displayed on the wake screen user interface **504**. In some embodiments, the device determines a luminosity of the background (e.g., by performing image analysis on a background image to determine a luminosity value. The background image of the wake screen is, e.g., e a default background image or a user-selected background image). The luminosity display mode switches based on the luminosity of the background. For example, a color of at least a portion of an area of one or more objects (e.g., a border around the object, a background of the object, text of the object, and/or an image displayed in the object) is changed when a luminosity mode changes (e.g., as described with regard to FIGS. **5**GV-**5**GW). The change in color causes the object to have a greater degree of contrast with the background image to increase the visibility of the object relative to the background image.

In some embodiments, while displaying the wake screen user interface, the device displays (**926**) a first object (e.g., a time-date indicator **582**) at a first position on the display **112** (e.g., the center of the first object is aligned with the horizontal symmetric center line of the display **112**). In accordance with the determination that the first swipe gesture is in the first direction (e.g., as shown in FIGS. **5**EK-**5**EL, the device displays the first object on the first user interface at a second position (e.g., as shown in FIG. **5**EM) that is shifted in the first direction relative to the first position on the display). When the first swipe is a right swipe, as shown in FIGS. **5**EK-**5**EL, the time indicator **582** is displayed on the right side of the mini-application-object user interface **5140** (e.g., in FIG. **5**EM) to provide a visual indication of the input needed (a swipe to the left) to return to the wake screen. In accordance with the determination that the first swipe gesture is in the second direction (e.g., as shown at FIGS. **5**EQ-**5**ER), the device displays the at least one object is at a third position (e.g., as shown in FIG. **5**ES) that is shifted in the second direction relative to the first position on the display (e.g., when the first swipe is a left swipe, the time indicator **582** is displayed on the left side of the control panel user interface **5138** to provide a visual indication of the input needed (a swipe to the right) to return to the wake screen).

Shifting a position of a first object (e.g., a time-date indicator) in response to swipe gesture input provides an indication of a location of a current user interface relative to the wake screen user interface. Providing an indication of a location of a current user interface relative to the wake screen user interface reduces the number of inputs needed to return to the wake screen user interface by reducing the need for a user (e.g., a user that is new to the interface arrangement) to experimentally swipe in order to recall the location of a desired user interface relative to a current user interface.

It should be understood that the particular order in which the operations in FIGS. **9**A-**9**C have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **600**, **700**, and **800**) are also applicable in an analogous manner to method **900** described above with respect to FIGS. **9**A-**9**C. For example, the contacts, gestures, user interface objects, intensity thresholds, focus selectors, and animations described above with reference to method xxx optionally have one or more of the characteristics of the contacts, gestures, user interface objects, intensity thresholds, focus selectors, and animations described herein with reference to other methods described herein (e.g., methods **600**, **700**, and **800**). For brevity, these details are not repeated here.

The operations described above with reference to FIGS. **9**A-**9**C are, optionally, implemented by components depicted in FIGS. **1**A-**1**B. For example, detection operation **902**, transitioning operation **904**, and displaying operation **908** are, optionally, implemented by event sorter **170**, event recognizer **180**, and event handler **190**. Event monitor **171** in event sorter **170** detects a contact on touch-sensitive display **112**, and event dispatcher module **174** delivers the event information to application **136-1**. A respective event recognizer **180** of application **136-1** compares the event information to respective event definitions **186**, and determines whether a first contact at a first location on the touch-sensitive surface (or whether rotation of the device) corresponds to a predefined event or sub-event, such as selection of an object on a user interface, or rotation of the device from one orientation to another. When a respective predefined event or sub-event is detected, event recognizer **180** activates an event handler **190** associated with the detection of the event or sub-event. Event handler **190** optionally uses or calls data updater **176** or object updater **177** to update the application internal state **192**. In some embodiments, event handler **190** accesses a respective GUI updater **178** to update what is displayed by the application. Similarly, it would be clear to a person having ordinary skill in the art how other processes can be implemented based on the components depicted in FIGS. **1**A-**1**B.

The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best use the invention and various described embodiments with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. A method, comprising:

at computer system that is in communication with a display generation component and one or more input devices:

while the computer system is in a power saving state, detecting an input that meets display-waking criteria;

in response to detecting the input that meets the display-waking criteria, displaying, via the display generation component, a wake screen user interface;

while displaying the wake screen user interface, detecting a first input that is directed to a portion of the wake screen user interface and includes first movement; and

in response to detecting the first input that is directed to the portion of the wake screen user interface:

in accordance with a determination that the first input meets first criteria, wherein the first criteria require the first movement to be in a first direction in order for the first criteria to be met:

displaying of a home screen user interface that is different from the wake screen user interface, wherein the home screen user interface includes a plurality of application icons corresponding to different applications, and wherein a respective application icon of the plurality of application icons, when selected, causes display of an application corresponding to the respective application icon; and

in accordance with a determination that the first input meets second criteria different from the first criteria, wherein the second criteria require the first movement to be in a second direction that is different from the first direction in order for the second criteria to be met:

displaying a widget screen user interface that is different from the wake screen user interface and the home screen user interface, wherein the widget screen user interface includes a plurality of user interface objects corresponding to different applications, wherein a respective user interface object of the plurality of user interface objects contains application content from an application corresponding to the respective user interface object, and when selected, causes display of an application corresponding to the respective user interface object.

2. The method of claim **1**, wherein the wake screen user interface is a user interface that has a first state that corresponds to an authenticated state of the computer system and a second state that corresponds to an unauthenticated state of the computer system.

3. The method of claim **1**, including:

while displaying the widget screen user interface, detecting a second input that is directed to a portion of the widget screen user interface and includes second movement; and

in response to detecting the second input that is directed to the portion of the widget screen user interface:

in accordance with a determination that the second input meets third criteria, wherein the third criteria require the second movement to be in the first direction in order for the second criteria to be met, displaying the home screen user interface.

4. The method of claim **3**, including:

while the home screen user interface is displayed in response to detection of the second input, detecting a third input that is directed to a portion of the home screen user interface and includes third movement; and

in response to detecting the third input that is directed to the portion of the home screen user interface:

in accordance with a determination that the third input meets fourth criteria, wherein the fourth criteria require the third movement to be in a third direction that is different from the first direction and the second direction in order for the fourth criteria to be met, redisplaying the widget screen user interface.

5. The method of claim **3**, including:

while the home screen user interface is displayed in response to detection of the second input, detecting a fourth input that is directed to a portion of the home screen user interface and includes fourth movement; and

in response to detecting the fourth input that is directed to the portion of the home screen user interface:

in accordance with a determination that the fourth input meets fifth criteria, wherein the fifth criteria require the fourth movement to be in a third direction that is different from the first direction and the second direction in order for the fifth criteria to be met, redisplaying the wake screen user interface.

6. The method of claim **1**, including:

while the home screen user interface is displayed in response to detection of the first input, detecting a fifth input that is directed to a portion of the home screen user interface and includes fifth movement; and

in response to detecting the fifth input that is directed to the portion of the home screen user interface:

in accordance with a determination that the fifth input meets sixth criteria, wherein the sixth criteria require the fifth movement to be in a fourth direction that is different from the first direction and the second direction in order for the sixth criteria to be met, redisplaying the wake screen user interface.

7. The method of claim **1**, including:

in response to detecting the first input that is directed to the portion of the wake screen user interface:

in accordance with a determination that the first input meets seventh criteria, wherein the seventh criteria require the first movement to be in a fifth direction that is different from the first direction and the second direction in order for the seventh criteria to be met:

displaying of a control panel user interface that is different from the wake screen user interface and the widget screen user interface, wherein the control panel user interface includes a plurality of controls for controlling one or more device functions of the computer system.

8. The method of claim **7**, including:

while the control panel user interface is displayed in response to detection of the first input, detecting a sixth input that is directed to a portion of the control panel user interface and includes sixth movement; and

in response to detecting the sixth input that is directed to the portion of the control panel user interface:

in accordance with a determination that the sixth input meets eighth criteria, wherein the eighth criteria require the sixth movement to be in a sixth direction (e.g., rightward swipe) that is opposite the fifth direction in order for the eighth criteria to be met, redisplaying the wake screen user interface.

9. A computer system, comprising:

one or more processors that are in communication with a display generation component and one or more input devices; and

memory storing instructions, the instructions, when executed by the one or more processors, cause the processors to perform operations comprising:

while the computer system is in a power saving state, detecting an input that meets display-waking criteria;

in response to detecting the input that meets the display-waking criteria, displaying, via the display generation component, a wake screen user interface;

while displaying the wake screen user interface, detecting a first input that is directed to a portion of the wake screen user interface and includes first movement; and

in response to detecting the first input that is directed to the portion of the wake screen user interface:

in accordance with a determination that the first input meets first criteria, wherein the first criteria require the first movement to be in a first direction in order for the first criteria to be met:

displaying of a home screen user interface that is different from the wake screen user interface, wherein the home screen user interface includes a plurality of application icons corresponding to different applications, and wherein a respective application icon of the plurality of application icons, when selected, causes display of an application corresponding to the respective application icon; and

in accordance with a determination that the first input meets second criteria different from the first criteria, wherein the second criteria require the first movement to be in a second direction that is different from the first direction in order for the second criteria to be met:

displaying a widget screen user interface that is different from the wake screen user interface and the home screen user interface, wherein the widget screen user interface includes a plurality of user interface objects corresponding to different applications, wherein a respective user interface object of the plurality of user interface objects contains application content from an application corresponding to the respective user interface object, and when selected, causes display of an application corresponding to the respective user interface object.

10. The computer system of claim **9**, wherein the wake screen user interface is a user interface that has a first state that corresponds to an authenticated state of the computer system and a second state that corresponds to an unauthenticated state of the computer system.

11. The computer system of claim **9**, wherein the operations include:

while displaying the widget screen user interface, detecting a second input that is directed to a portion of the widget screen user interface and includes second movement; and

in response to detecting the second input that is directed to the portion of the widget screen user interface:

in accordance with a determination that the second input meets third criteria, wherein the third criteria require the second movement to be in the first direction in order for the second criteria to be met, displaying the home screen user interface.

12. The computer system of claim **11**, wherein the operations include:

while the home screen user interface is displayed in response to detection of the second input, detecting a third input that is directed to a portion of the home screen user interface and includes third movement; and

in response to detecting the third input that is directed to the portion of the home screen user interface:

in accordance with a determination that the third input meets fourth criteria, wherein the fourth criteria require the third movement to be in a third direction that is different from the first direction and the second direction in order for the fourth criteria to be met, redisplaying the widget screen user interface.

13. The computer system of claim **11**, wherein the operations include:

while the home screen user interface is displayed in response to detection of the second input, detecting a fourth input that is directed to a portion of the home screen user interface and includes fourth movement; and

in response to detecting the fourth input that is directed to the portion of the home screen user interface:

in accordance with a determination that the fourth input meets fifth criteria, wherein the fifth criteria require the fourth movement to be in a third direction that is different from the first direction and the second direction in order for the fifth criteria to be met, redisplaying the wake screen user interface.

14. The computer system of claim **9**, wherein the operations include:

while the home screen user interface is displayed in response to detection of the first input, detecting a fifth input that is directed to a portion of the home screen user interface and includes fifth movement; and

in response to detecting the fifth input that is directed to the portion of the home screen user interface:

in accordance with a determination that the fifth input meets sixth criteria, wherein the sixth criteria require the fifth movement to be in a fourth direction that is different from the first direction and the second direction in order for the sixth criteria to be met, redisplaying the wake screen user interface.

15. The computer system of claim **9**, wherein the operations include:

in response to detecting the first input that is directed to the portion of the wake screen user interface:

in accordance with a determination that the first input meets seventh criteria, wherein the seventh criteria require the first movement to be in a fifth direction that is different from the first direction and the second direction in order for the seventh criteria to be met:

displaying of a control panel user interface that is different from the wake screen user interface and the widget screen user interface, wherein the control panel user interface includes a plurality of controls for controlling one or more device functions of the computer system.

16. The computer system of claim **15**, wherein the operations include

while the control panel user interface is displayed in response to detection of the first input, detecting a sixth input that is directed to a portion of the control panel user interface and includes sixth movement; and

in response to detecting the sixth input that is directed to the portion of the control panel user interface:

in accordance with a determination that the sixth input meets eighth criteria, wherein the eighth criteria require the sixth movement to be in a sixth direction (e.g., rightward swipe) that is opposite the fifth direction in order for the eighth criteria to be met, redisplaying the wake screen user interface.

17. A computer-readable storage medium comprising instructions, the instructions, when executed by one or more processors of a computer system that is in communication with a display generation component and one or more input devices, cause the processors to perform operations comprising:

while the computer system is in a power saving state, detecting an input that meets display-waking criteria;

in response to detecting the input that meets the display-waking criteria, displaying, via the display generation component, a wake screen user interface;

while displaying the wake screen user interface, detecting a first input that is directed to a portion of the wake screen user interface and includes first movement; and

in response to detecting the first input that is directed to the portion of the wake screen user interface:

in accordance with a determination that the first input meets first criteria, wherein the first criteria require the first movement to be in a first direction in order for the first criteria to be met:

displaying of a home screen user interface that is different from the wake screen user interface, wherein the home screen user interface includes a plurality of application icons corresponding to different applications, and wherein a respective application icon of the plurality of application icons, when selected, causes display of an application corresponding to the respective application icon; and

in accordance with a determination that the first input meets second criteria different from the first criteria, wherein the second criteria require the first movement to be in a second direction that is different from the first direction in order for the second criteria to be met:

displaying a widget screen user interface that is different from the wake screen user interface and the home screen user interface, wherein the widget screen user interface includes a plurality of user interface objects corresponding to different applications, wherein a respective user interface object of the plurality of user interface objects contains application content from an application corresponding to the respective user interface object, and when selected, causes display of an application corresponding to the respective user interface object.

18. The computer-readable storage medium of claim **17**, wherein the wake screen user interface is a user interface that has a first state that corresponds to an authenticated state of the computer system and a second state that corresponds to an unauthenticated state of the computer system.

19. The computer-readable storage medium of claim **17**, wherein the operations include:

while displaying the widget screen user interface, detecting a second input that is directed to a portion of the widget screen user interface and includes second movement; and

in response to detecting the second input that is directed to the portion of the widget screen user interface:

in accordance with a determination that the second input meets third criteria, wherein the third criteria require the second movement to be in the first direction in order for the second criteria to be met, displaying the home screen user interface.

20. The computer-readable storage medium of claim **19**, wherein the operations include:

while the home screen user interface is displayed in response to detection of the second input, detecting a third input that is directed to a portion of the home screen user interface and includes third movement; and

in response to detecting the third input that is directed to the portion of the home screen user interface:

in accordance with a determination that the third input meets fourth criteria, wherein the fourth criteria require the third movement to be in a third direction that is different from the first direction and the second direction in order for the fourth criteria to be met, redisplaying the widget screen user interface.

21. The computer-readable storage medium of claim **19**, wherein the operations include:

while the home screen user interface is displayed in response to detection of the second input, detecting a fourth input that is directed to a portion of the home screen user interface and includes fourth movement; and

in response to detecting the fourth input that is directed to the portion of the home screen user interface:

in accordance with a determination that the fourth input meets fifth criteria, wherein the fifth criteria require the fourth movement to be in a third direction that is different from the first direction and the second direction in order for the fifth criteria to be met, redisplaying the wake screen user interface.

22. The computer-readable storage medium of claim **17**, wherein the operations include:

while the home screen user interface is displayed in response to detection of the first input, detecting a fifth input that is directed to a portion of the home screen user interface and includes fifth movement; and

in response to detecting the fifth input that is directed to the portion of the home screen user interface:

in accordance with a determination that the fifth input meets sixth criteria, wherein the sixth criteria require the fifth movement to be in a fourth direction that is different from the first direction and the second direction in order for the sixth criteria to be met, redisplaying the wake screen user interface.

23. The computer-readable storage medium of claim **17**, wherein the operations include:

in response to detecting the first input that is directed to the portion of the wake screen user interface:

in accordance with a determination that the first input meets seventh criteria, wherein the seventh criteria require the first movement to be in a fifth direction that is different from the first direction and the second direction in order for the seventh criteria to be met:

displaying of a control panel user interface that is different from the wake screen user interface and the widget screen user interface, wherein the control panel user interface includes a plurality of controls for controlling one or more device functions of the computer system.

24. The computer-readable storage medium of claim **23**, wherein the operations include

while the control panel user interface is displayed in response to detection of the first input, detecting a sixth input that is directed to a portion of the control panel user interface and includes sixth movement; and

in response to detecting the sixth input that is directed to the portion of the control panel user interface:

in accordance with a determination that the sixth input meets eighth criteria, wherein the eighth criteria require the sixth movement to be in a sixth direction (e.g., rightward swipe) that is opposite the fifth direction in order for the eighth criteria to be met, redisplaying the wake screen user interface.

* * * * *

EXHIBIT F

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(12) **United States Patent**
Rothkopf et al.

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(54) **WEARABLE ELECTRONIC DEVICE**

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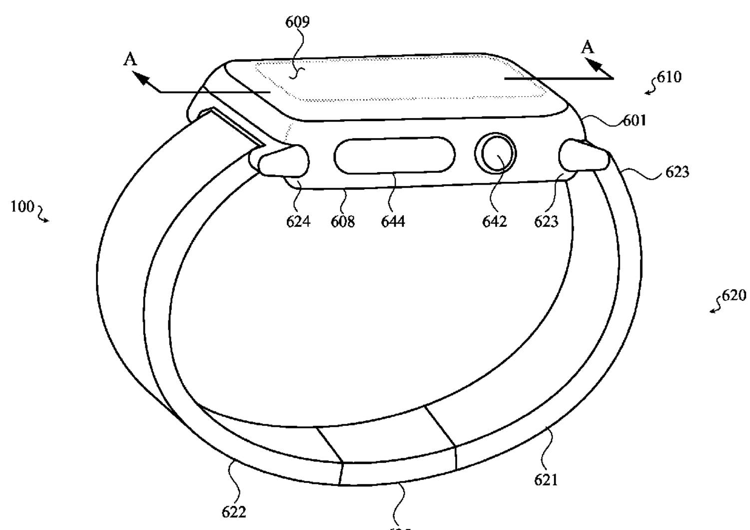
(57) **ABSTRACT**

A consumer product that is a portable and, in some cases, a wearable electronic device. The wearable electronic device may have functionalities including: keeping time; monitoring a user's physiological signals and providing health-related information based on those signals; communicating with other electronic devices or services; visually depicting data on a display; gather data form one or more sensors that may be used to initiate, control, or modify operations of the device; determine a location of a touch on a surface of the device and/or an amount of force exerted on the device, and use either or both as input.

20 Claims, 26 Drawing Sheets



Related U.S. Application Data

17/188,966, filed on Mar. 1, 2021, which is a continuation of application No. 16/826,130, filed on Mar. 20, 2020, now Pat. No. 10,942,491, said application No. 17/188,995 is a continuation of application No. 16/826,130, filed on Mar. 20, 2020, now Pat. No. 10,942,491, which is a continuation of application No. 15/261,917, filed on Sep. 10, 2016, now Pat. No. 10,627,783, and a continuation of application No. 15/261,912, filed on Sep. 10, 2016, now Pat. No. 10,620,591, and a continuation of application No. 15/261,914, filed on Sep. 10, 2016, now Pat. No. 10,613,485, and a continuation of application No. 14/842,617, filed on Sep. 1, 2015, now Pat. No. 10,599,101, said application No. 15/261,917 is a continuation of application No. 14/842,617, filed on Sep. 1, 2015, now Pat. No. 10,599,101, said application No. 15/261,914 is a continuation of application No. 14/842,617, filed on Sep. 1, 2015, now Pat. No. 10,599,101, said application No. 15/261,912 is a continuation of application No. 14/842,617, filed on Sep. 1, 2015, now Pat. No. 10,599,101.

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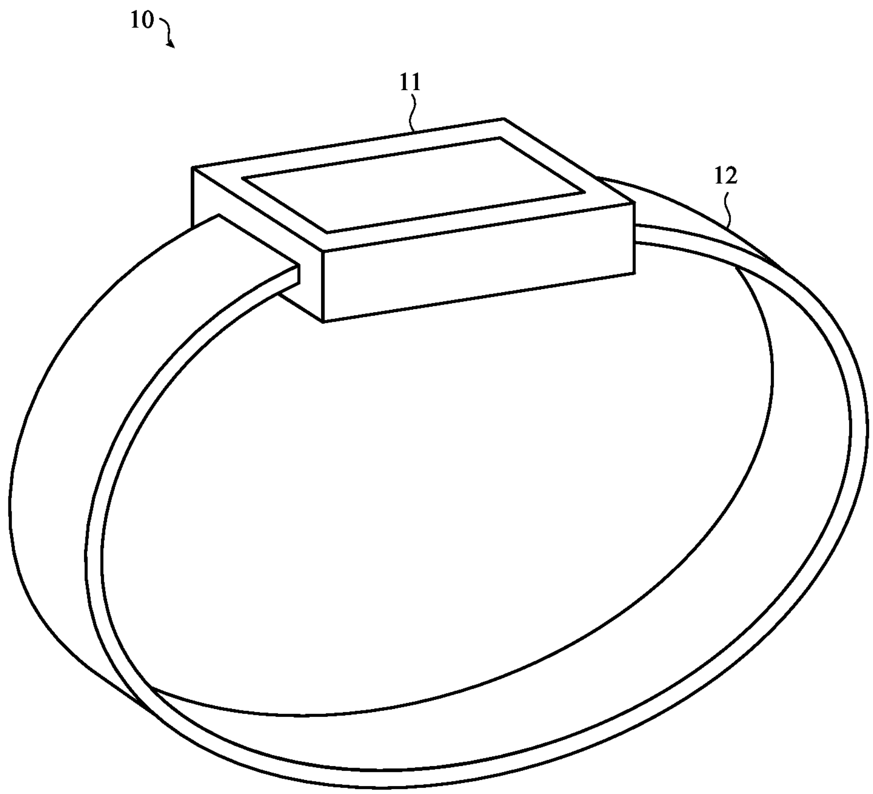
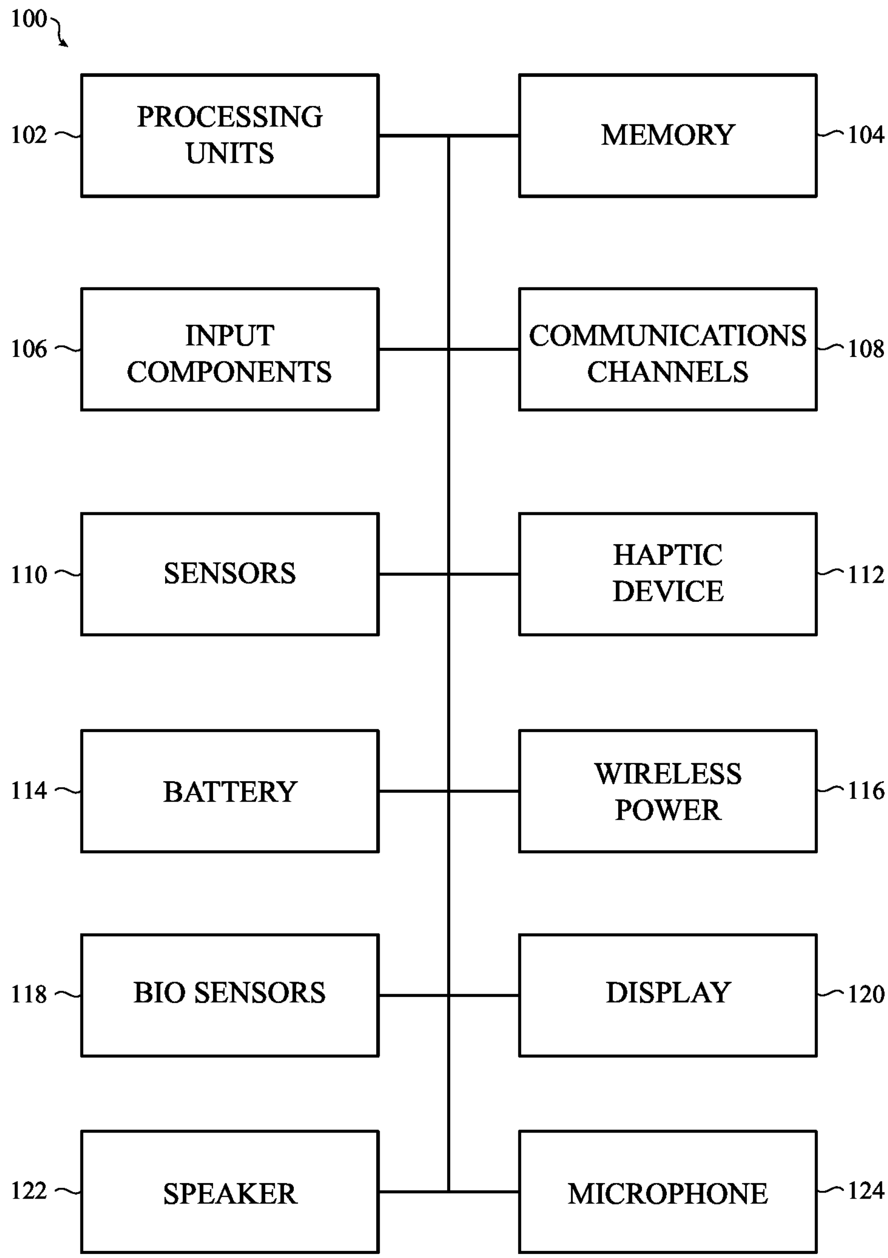


FIG. 1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SENSORS
HAPTIC DEVICE
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BATTERY
WIRELESS POWER
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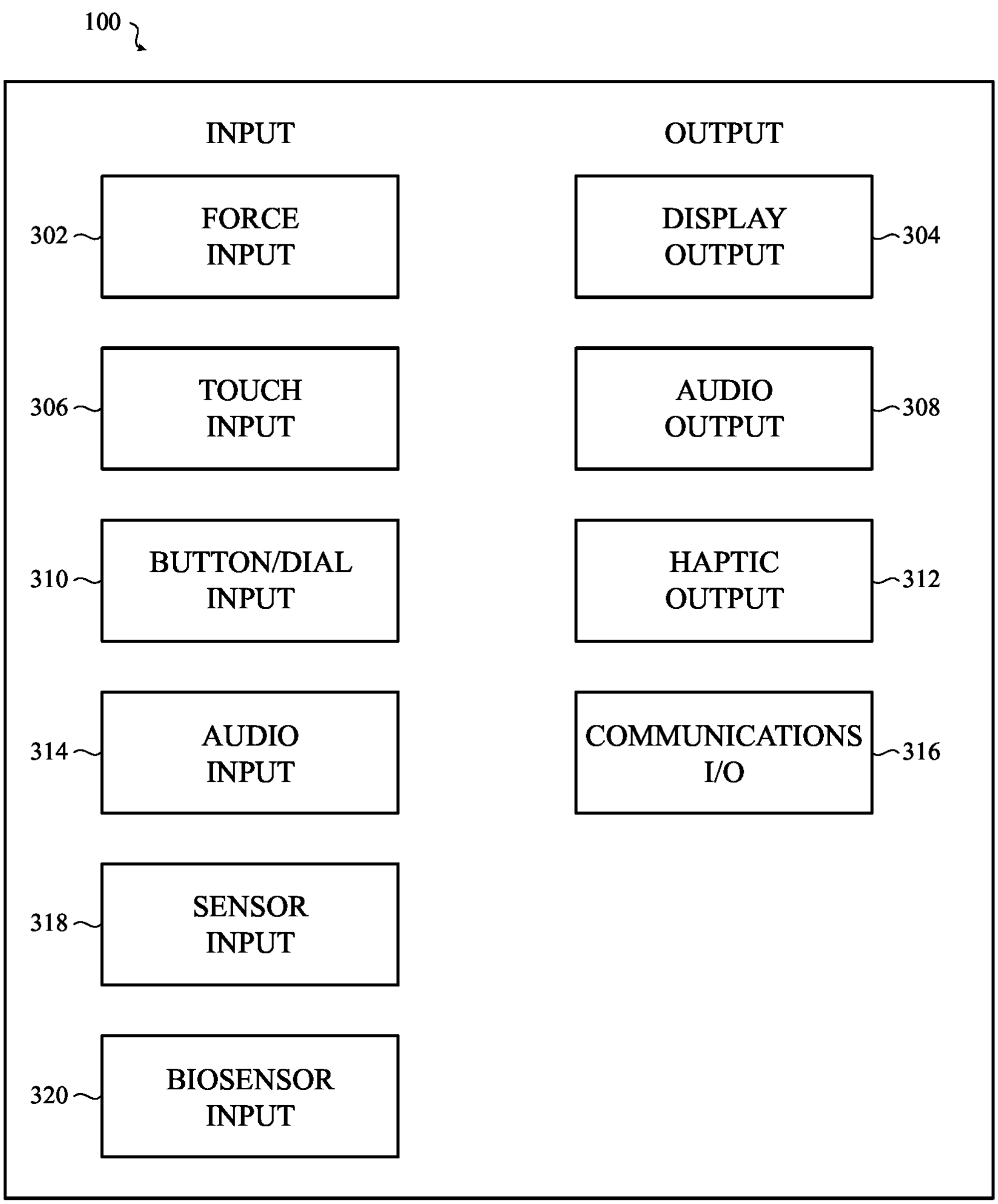
118
BIO SENSORS
DISPLAY
120
122
SPEAKER
MICROPHONE
124

FIG. 2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DISPLAY OUTPUT
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TOUCH INPUT
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AUDIO OUTPUT
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BUTTON/DIAL INPUT
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AUDIO INPUT
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COMMUNICATIONS I/O
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SENSOR INPUT
318
BIOSENSOR INPUT
320

FIG. 3

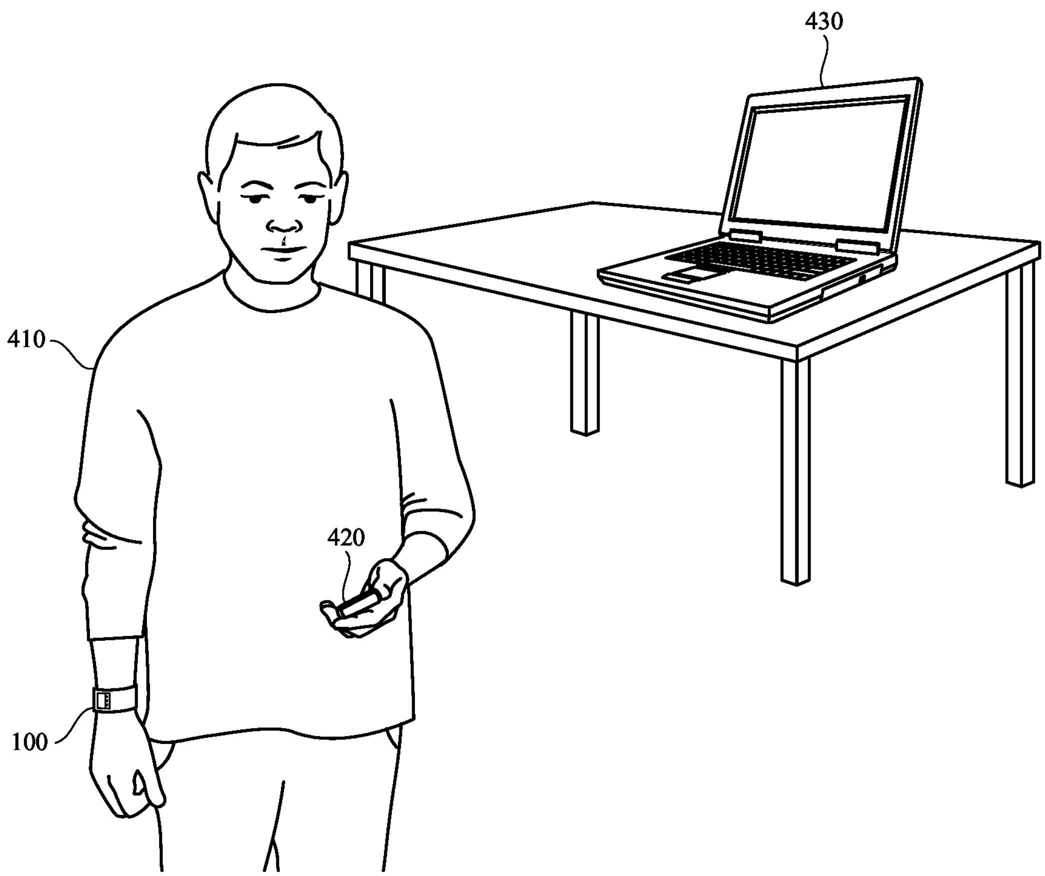

FIG. 4

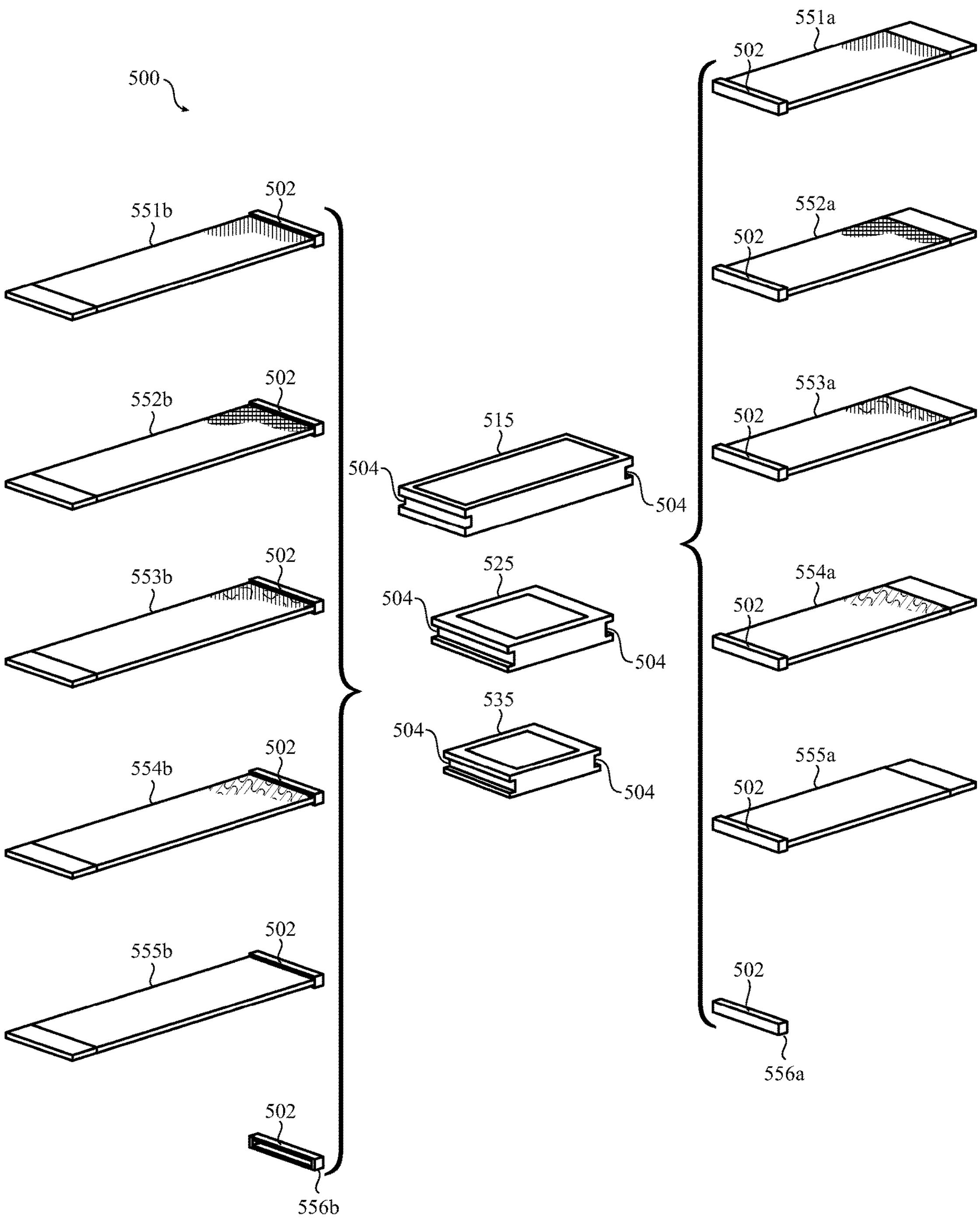
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FIG. 5

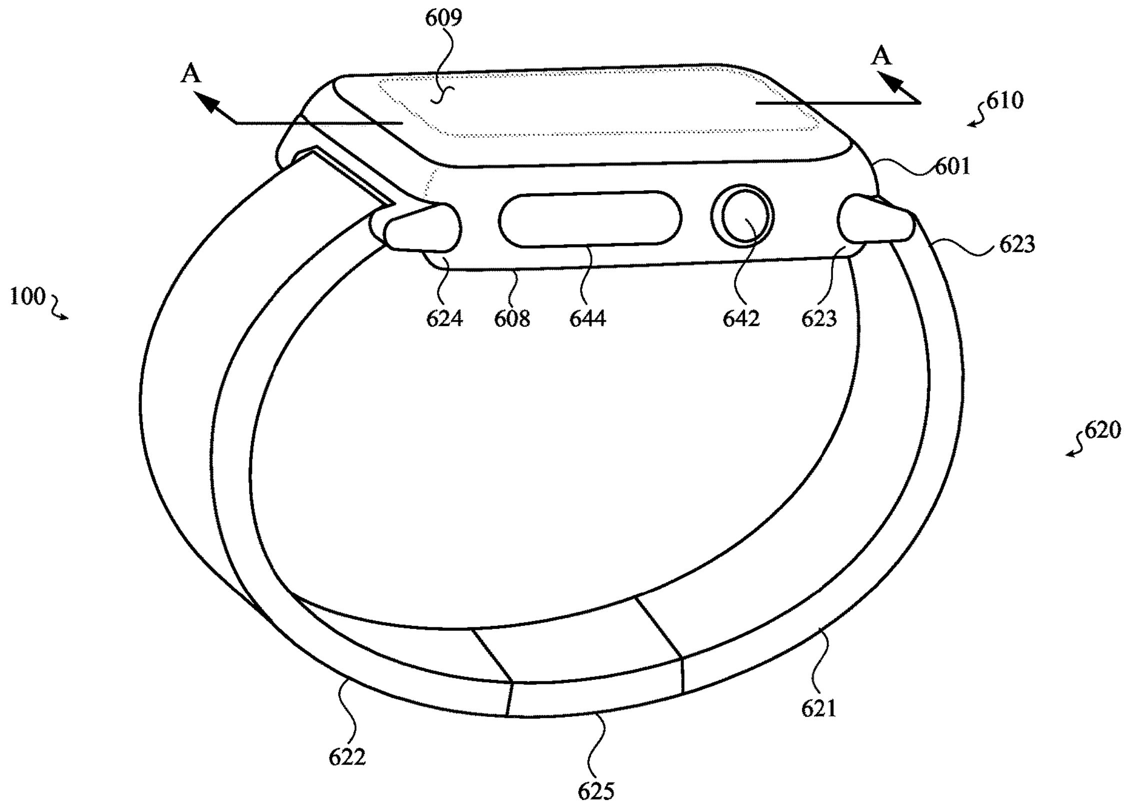

FIG. 6

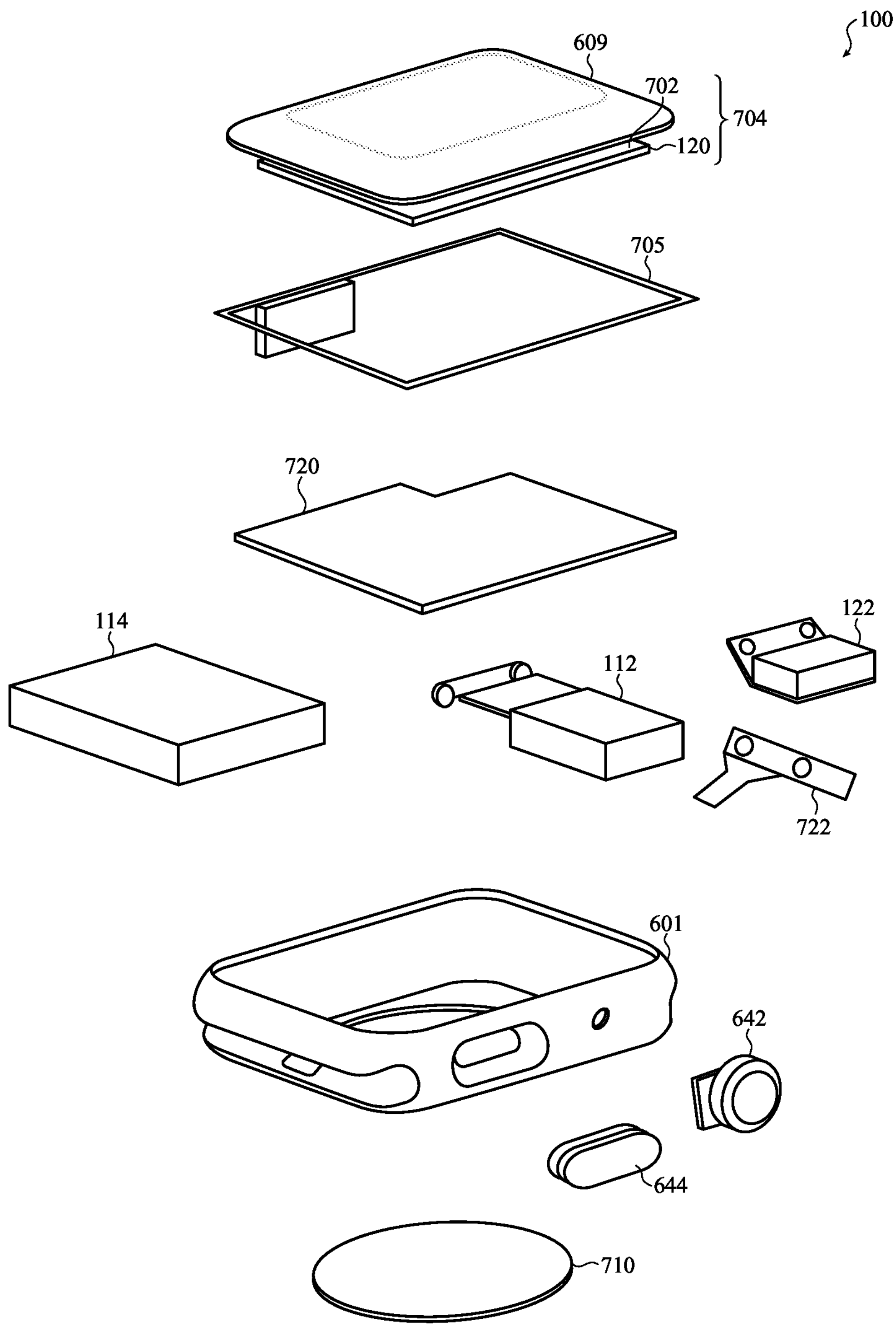

FIG. 7

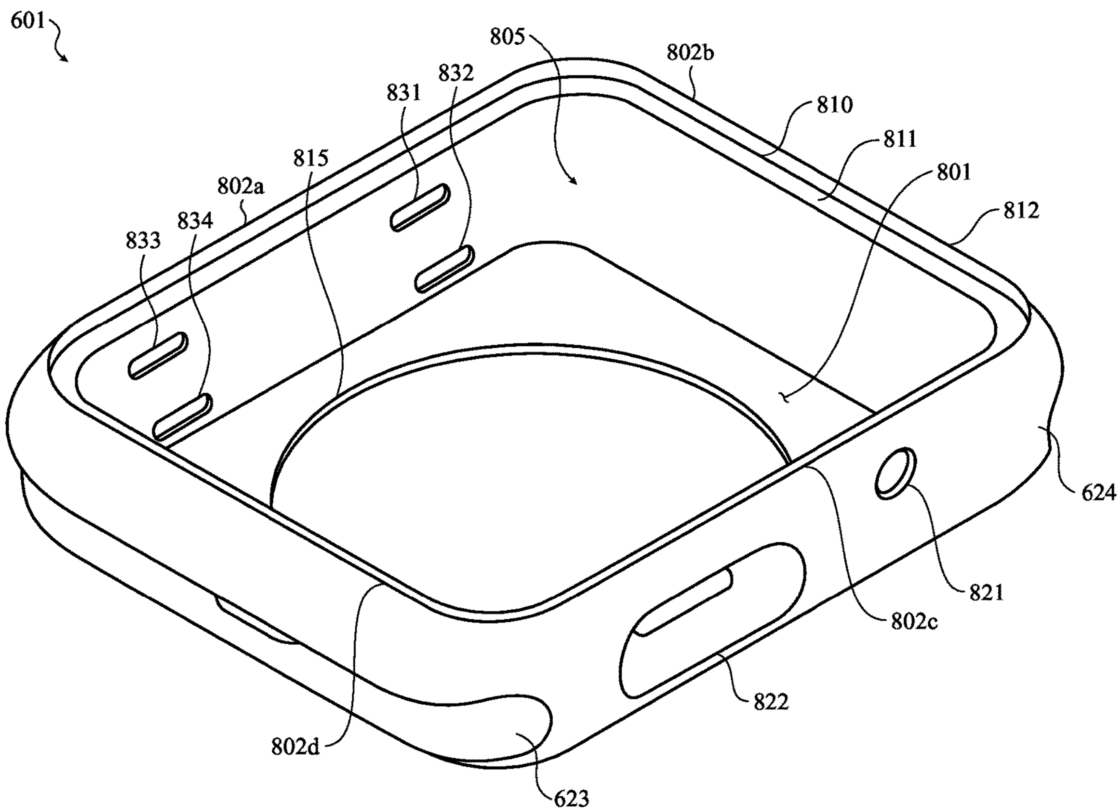
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FIG. 8

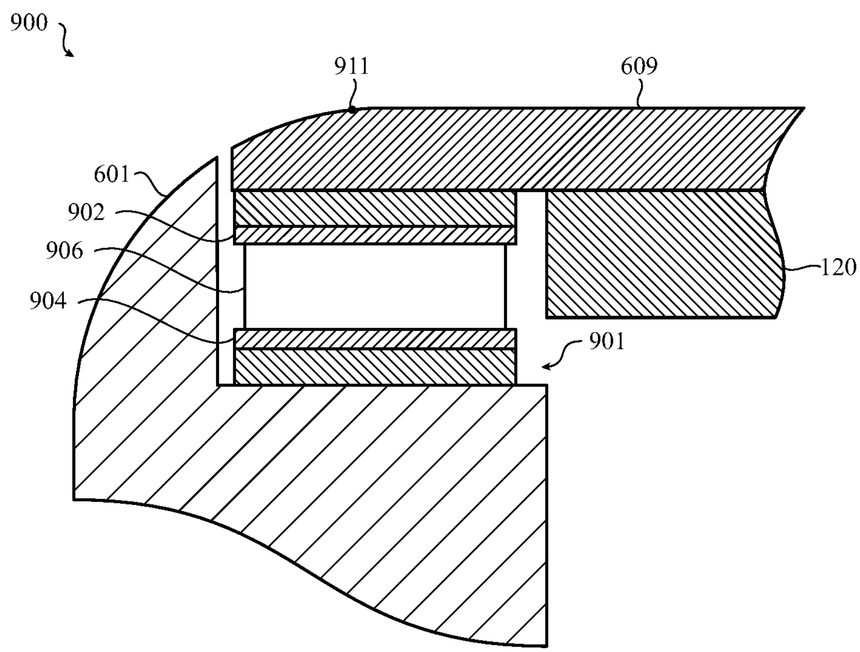

FIG. 9

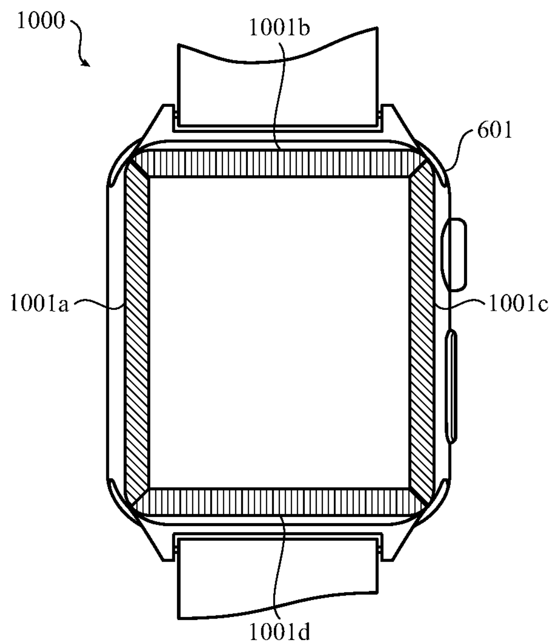

FIG. 10A

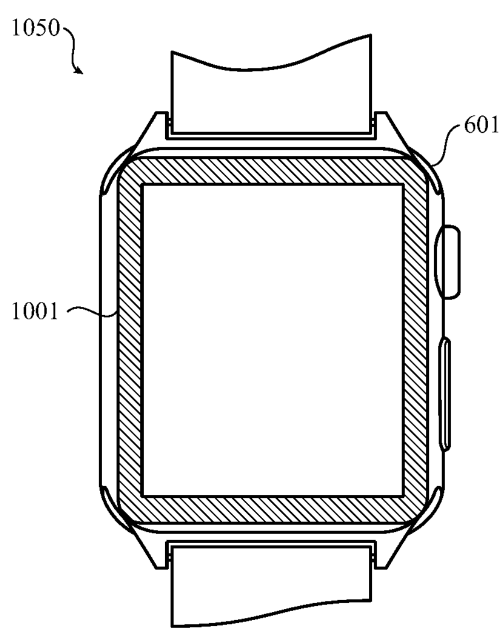

FIG. 10B

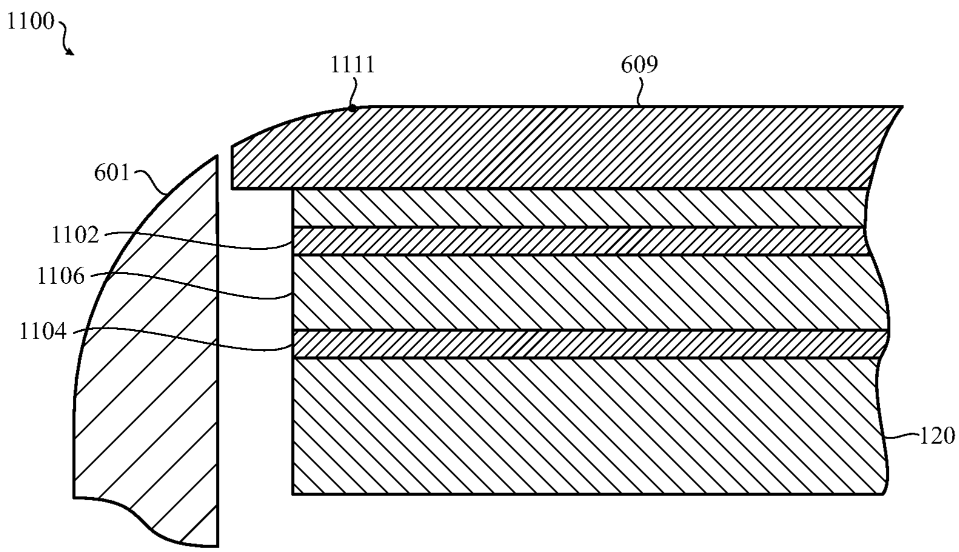

FIG. 11

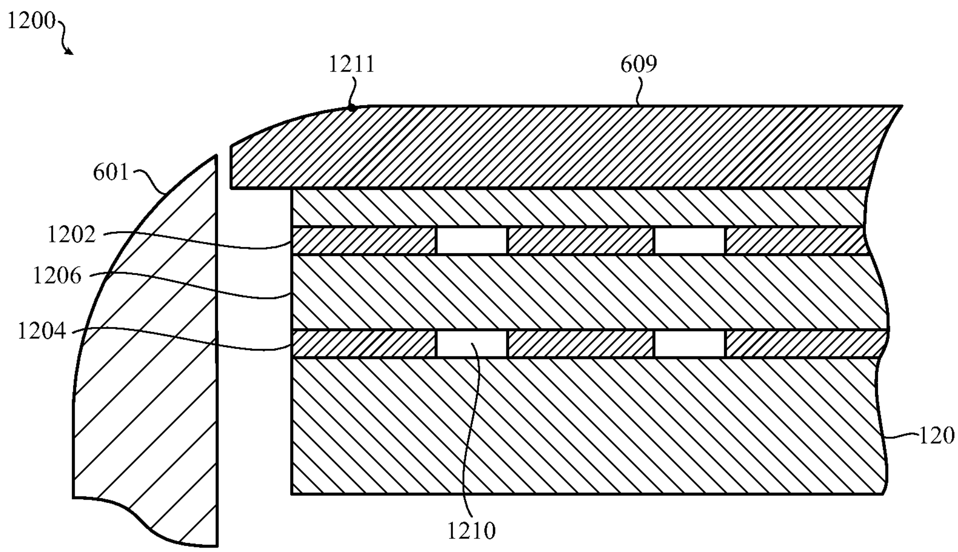

FIG. 12

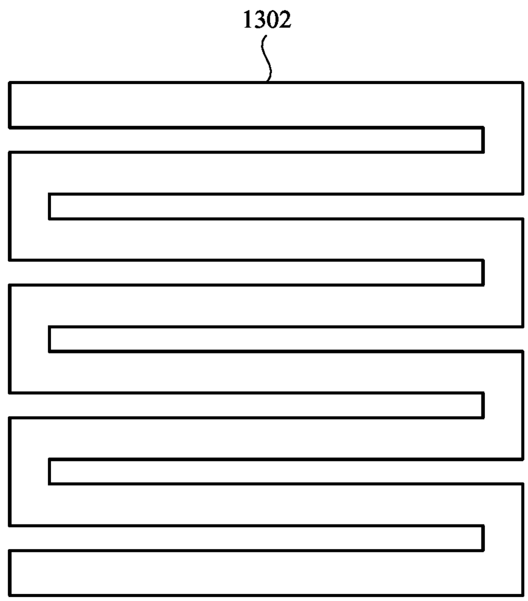

FIG. 13A

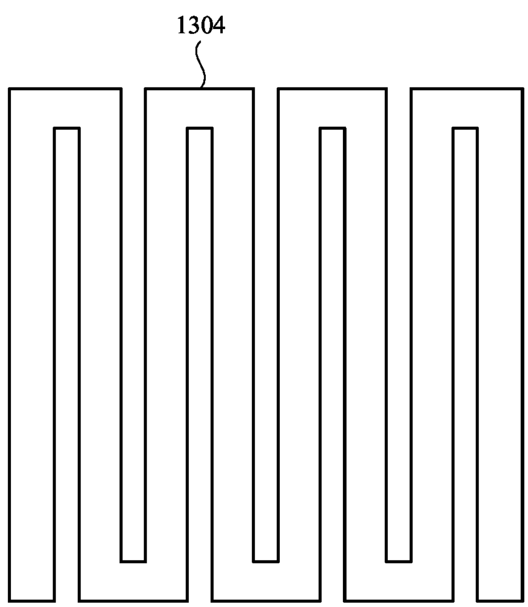

FIG. 13B

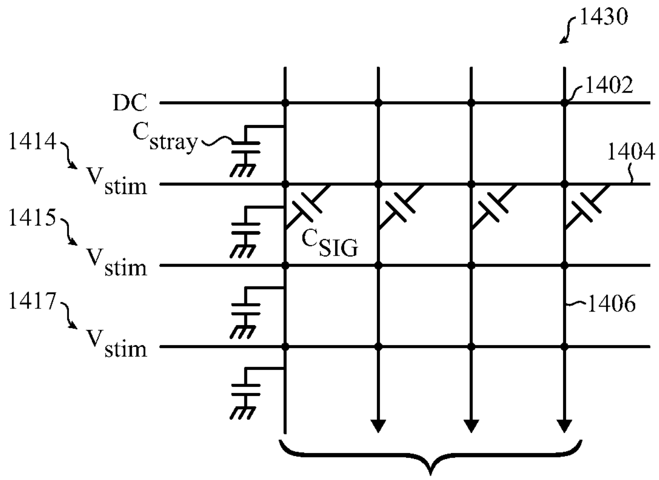

FIG. 14A

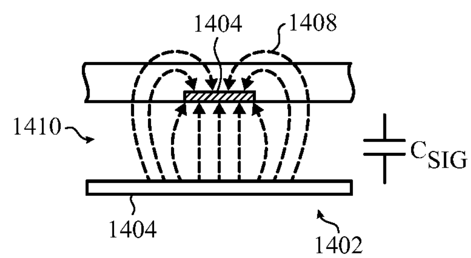

FIG. 14B

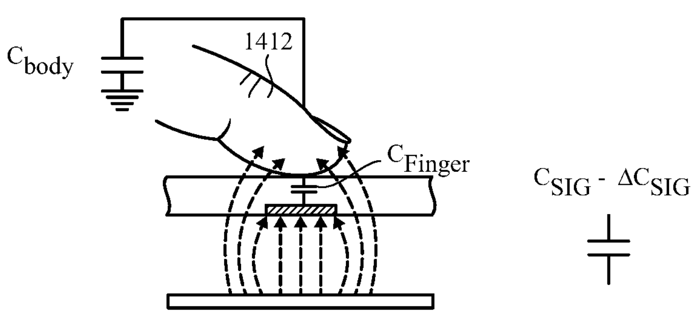

FIG. 14C

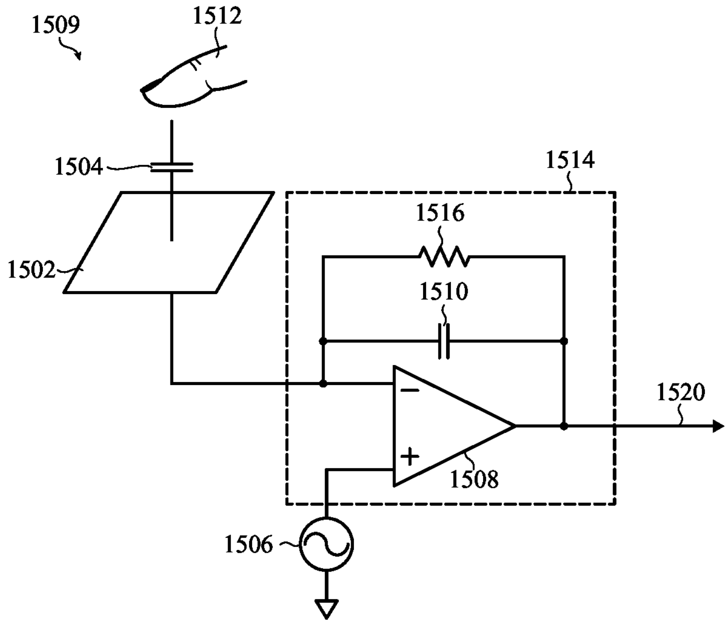

FIG. 15A

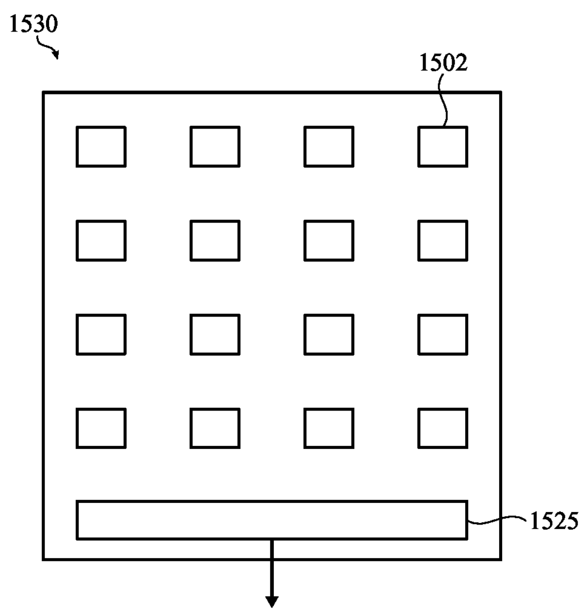

FIG. 15B

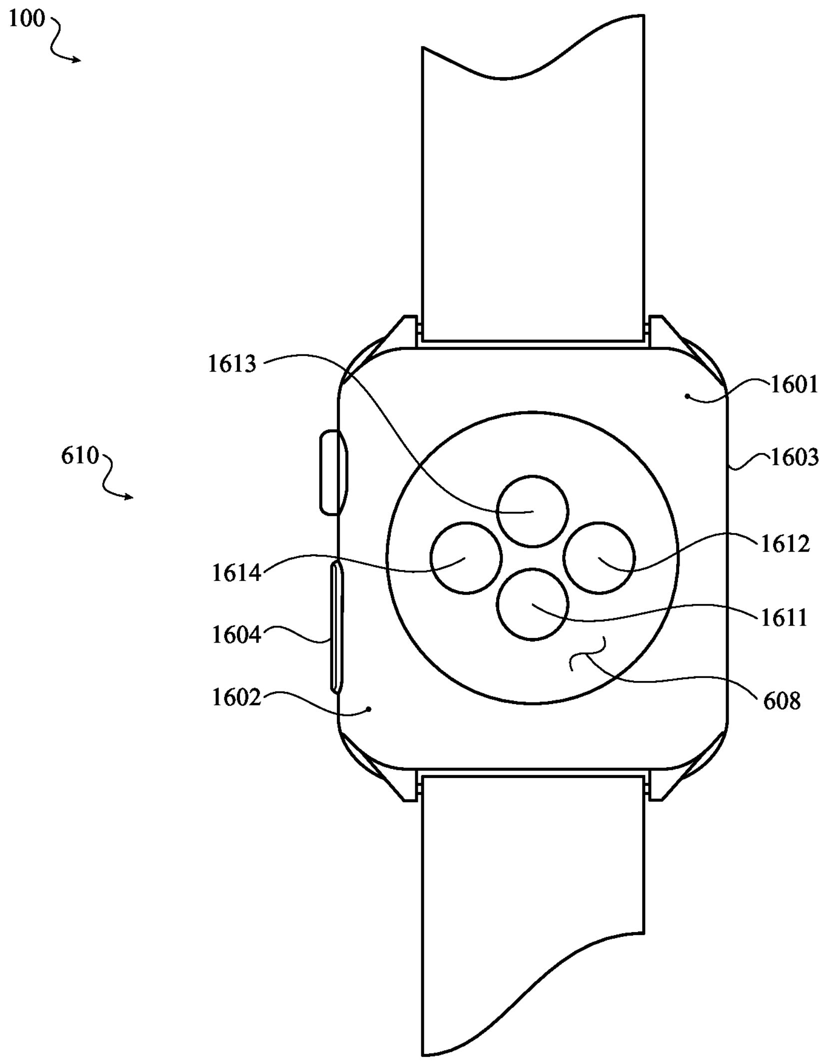

FIG. 16

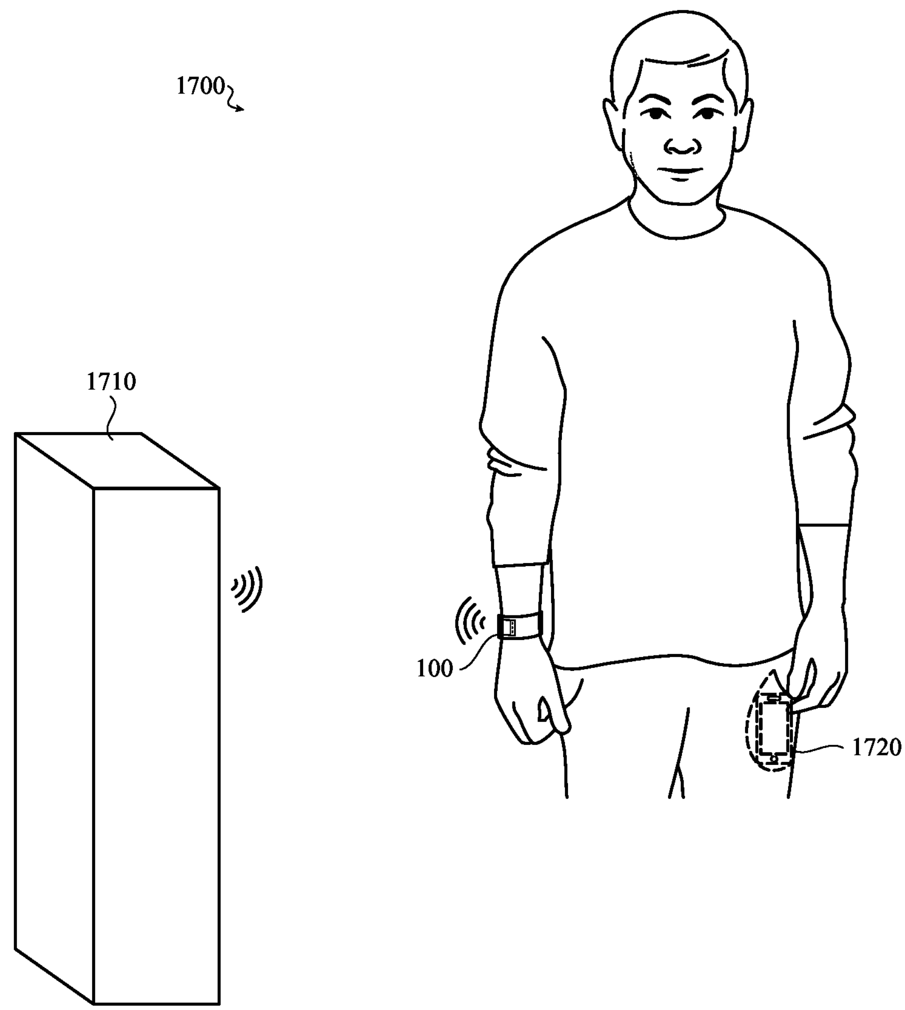

FIG. 17

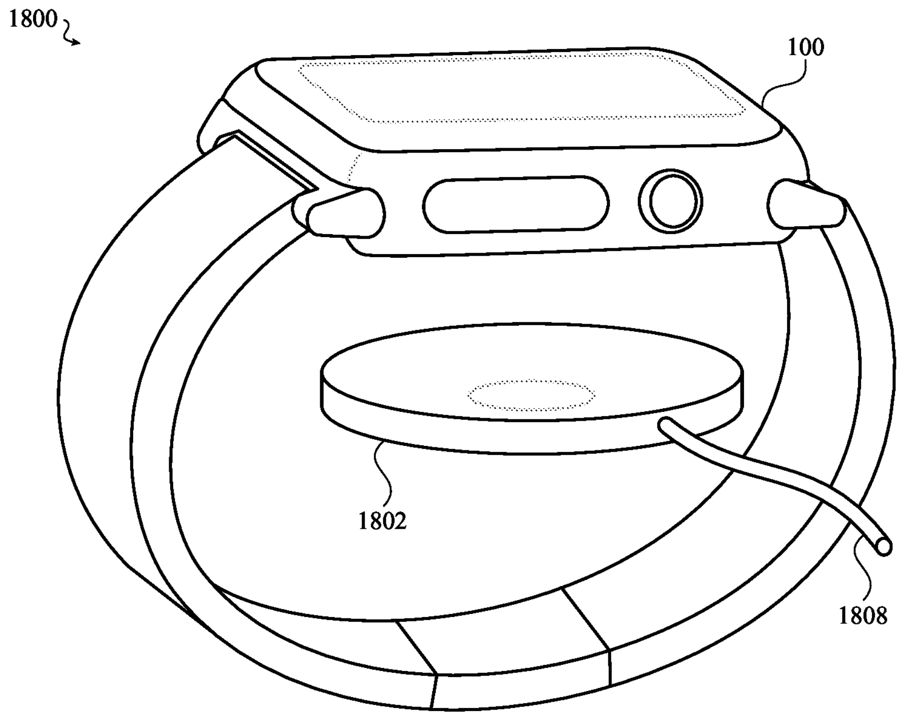

FIG. 18

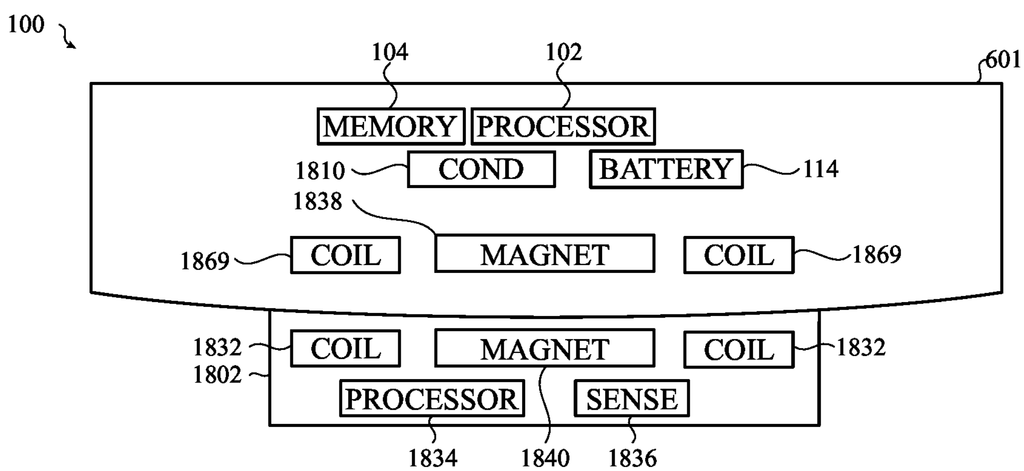
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FIG. 19

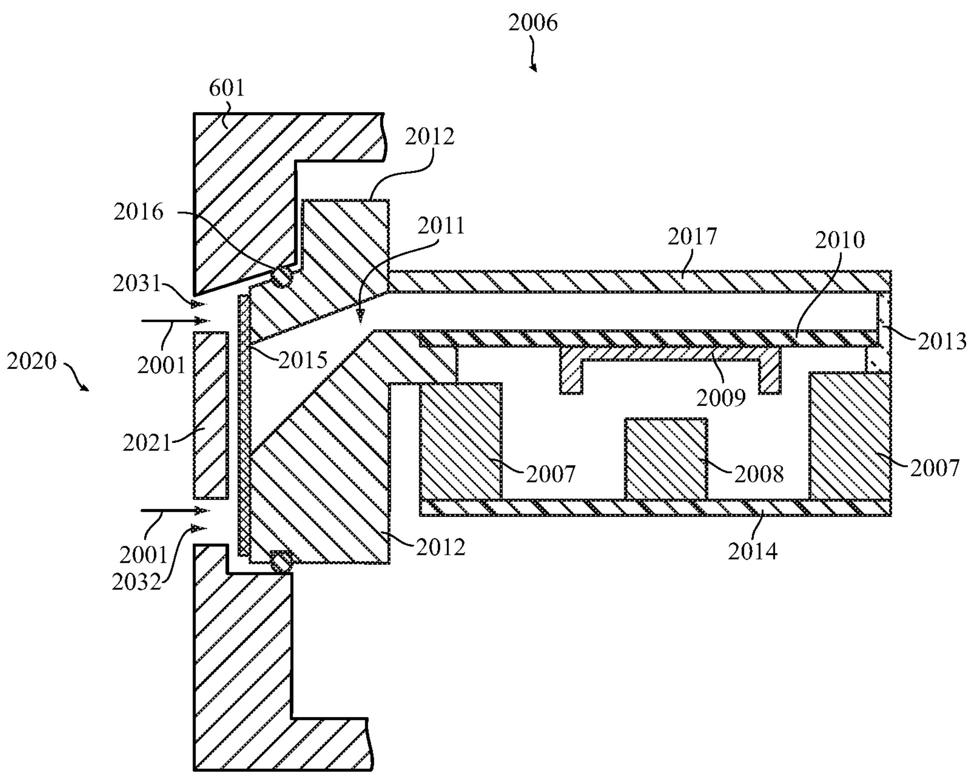
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FIG. 20

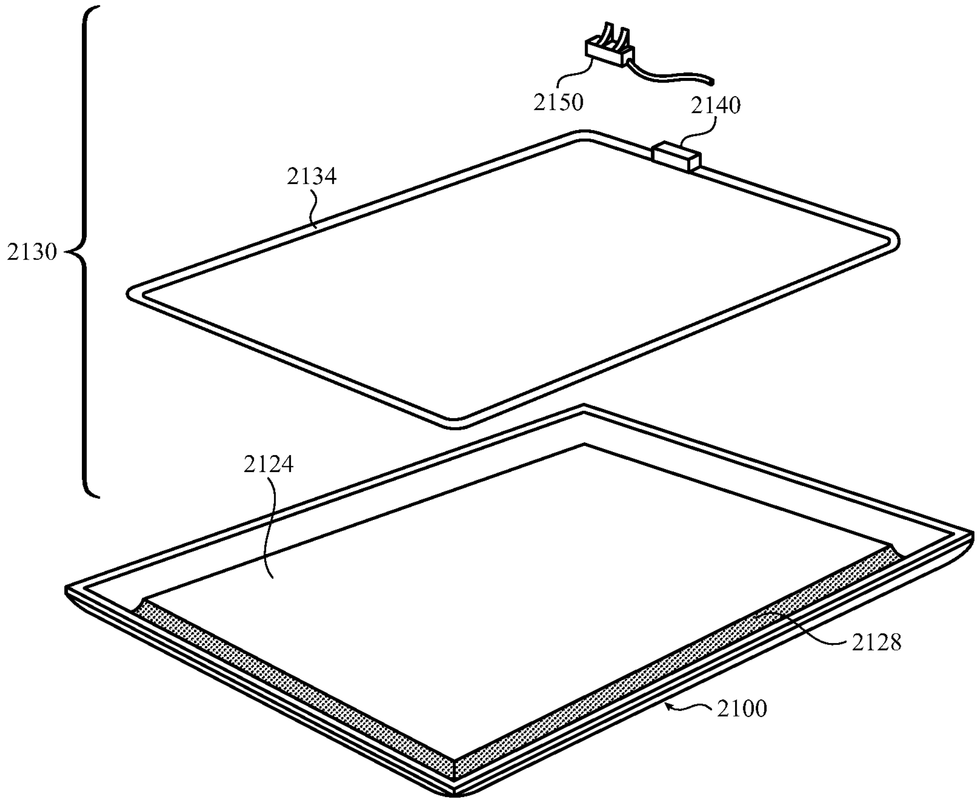

FIG. 21A

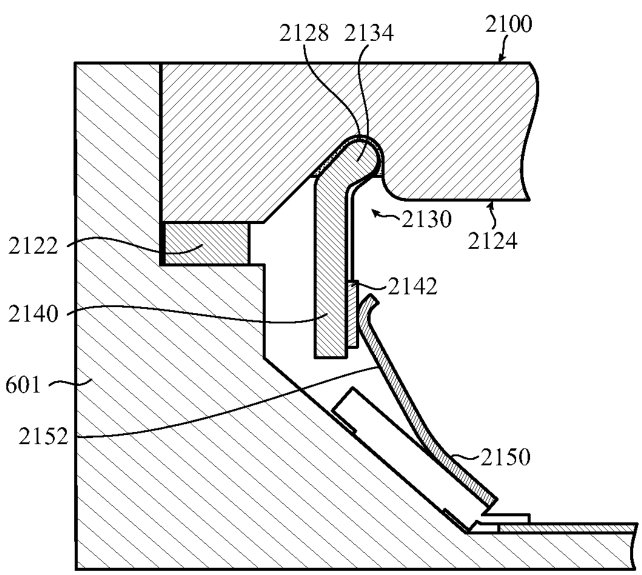

FIG. 21B

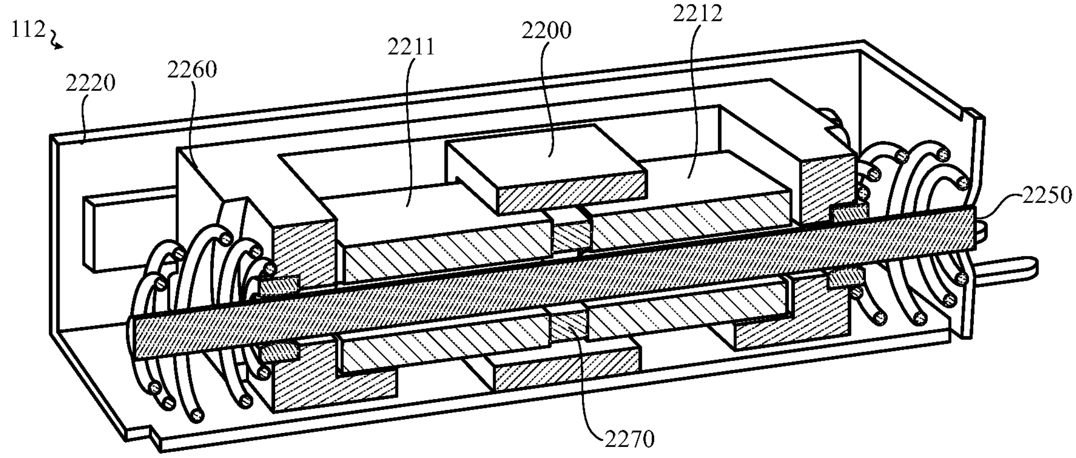

FIG. 22A

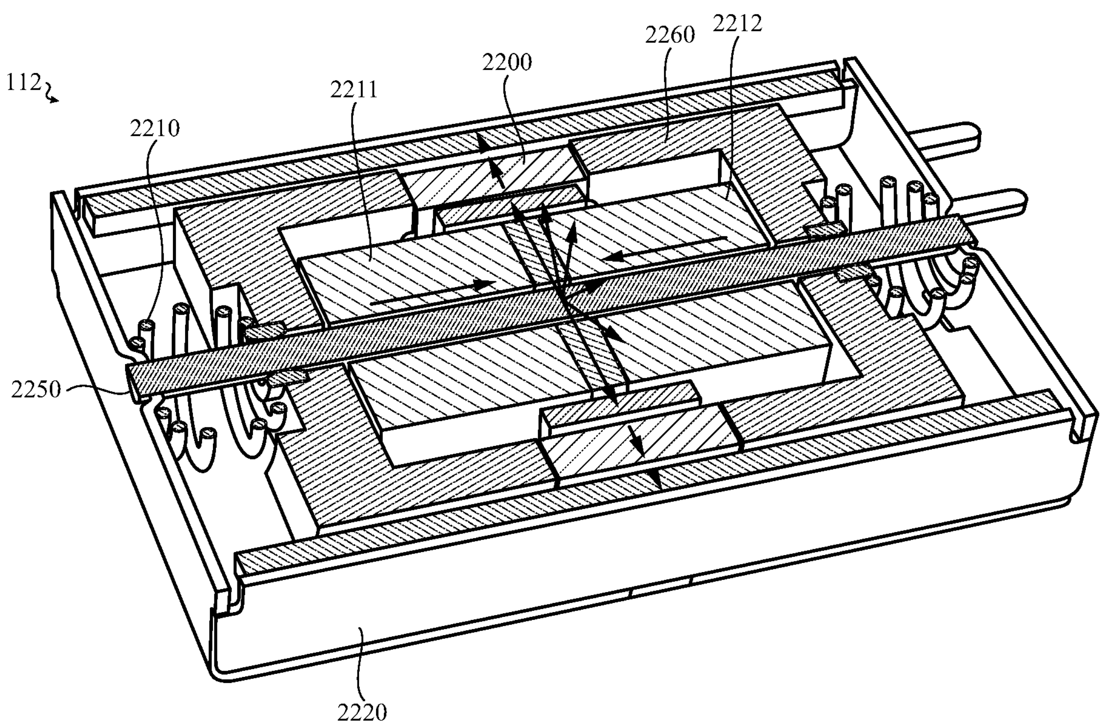

FIG. 22B

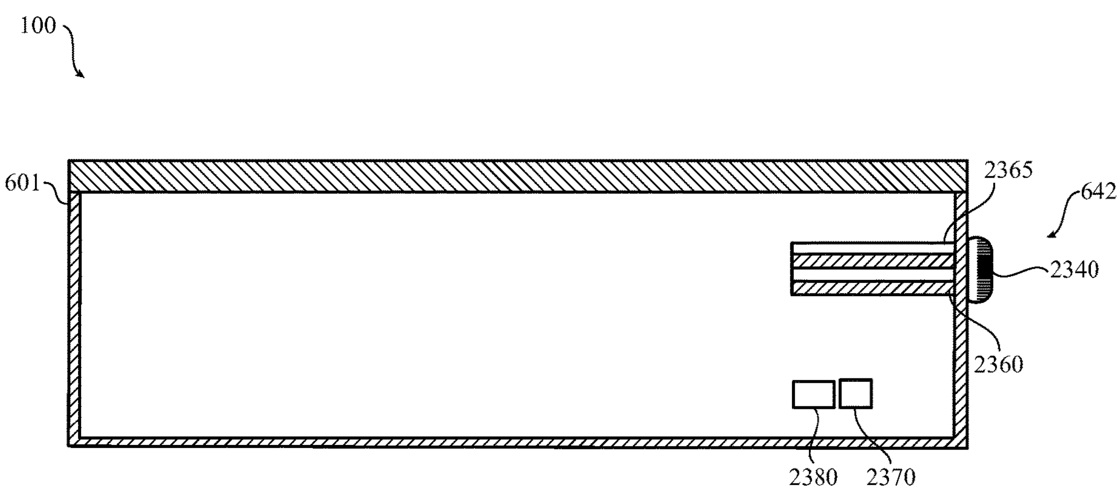

FIG. 23

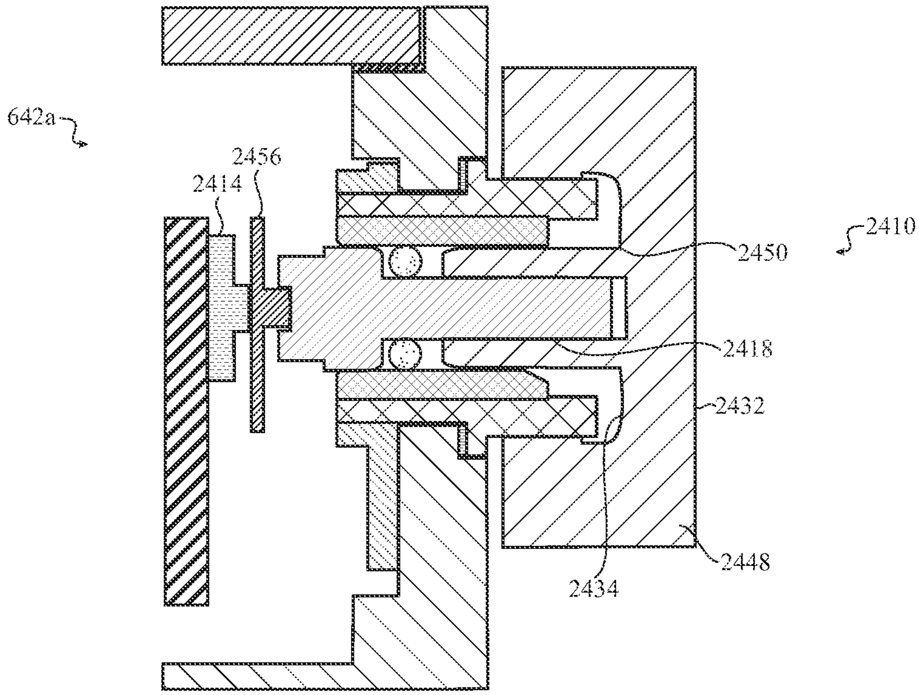

FIG. 24A

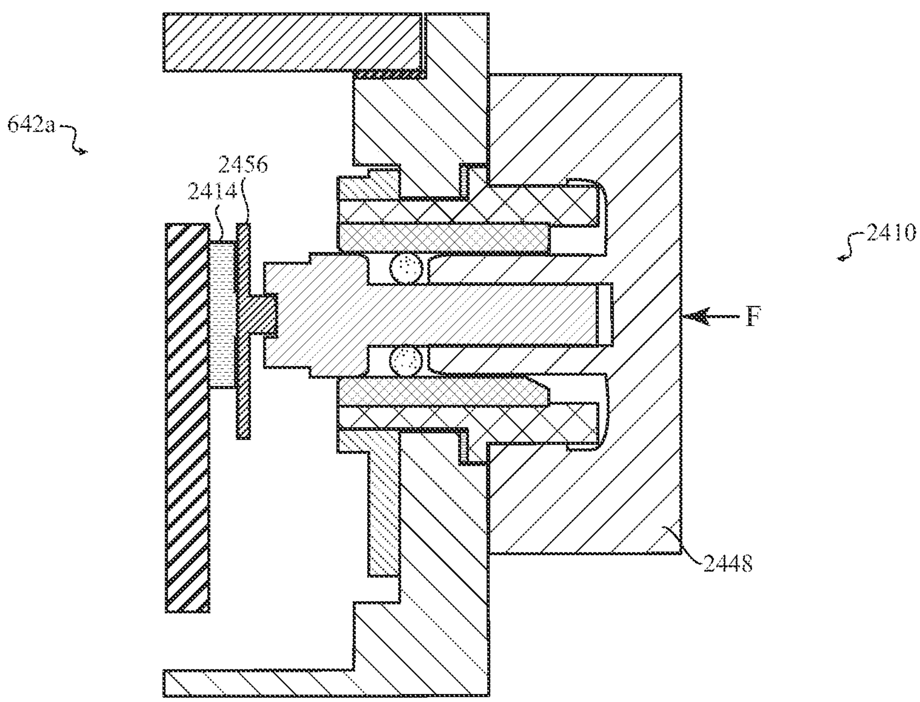

FIG. 24B

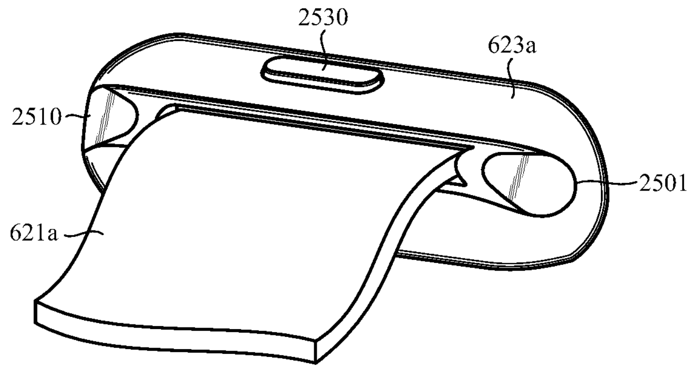

FIG. 25A

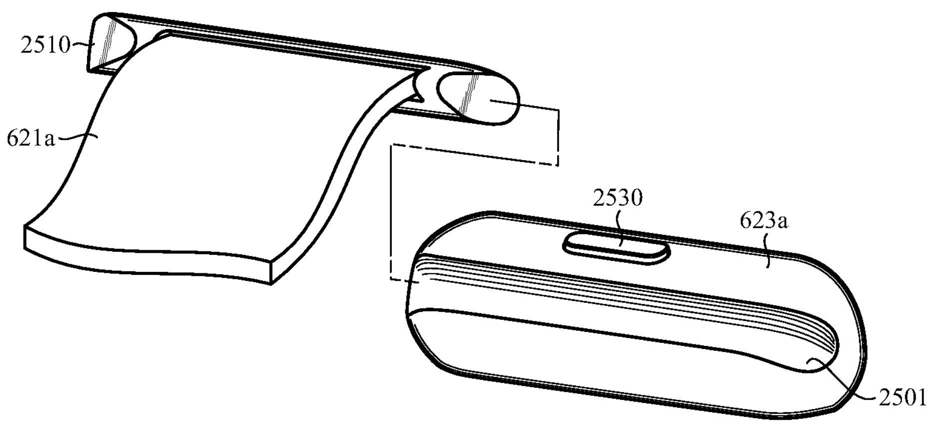

FIG. 25B

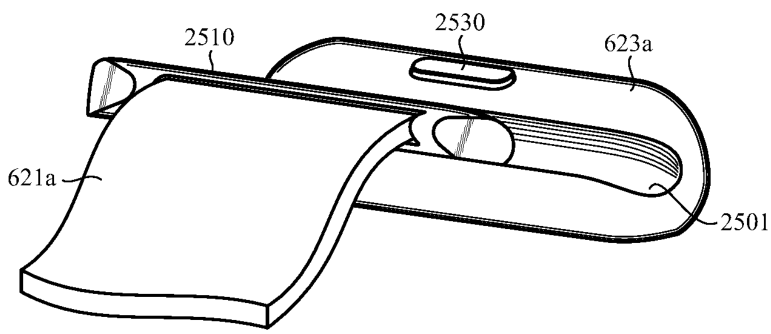

FIG. 25C

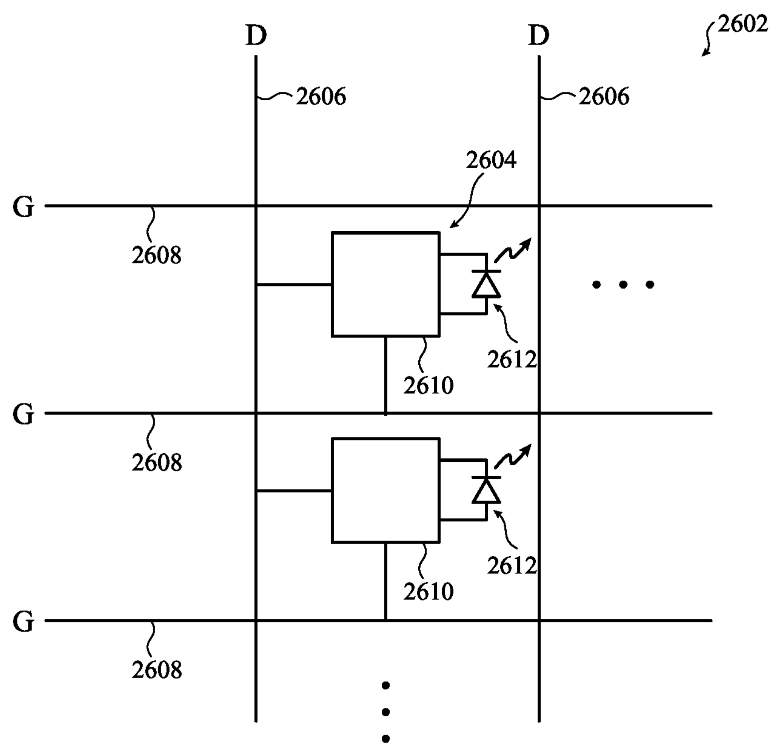

FIG. 26

WEARABLE ELECTRONIC DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation patent application of U.S. patent application Ser. No. 17/188,966, filed Mar. 1, 2021, and titled "Wearable Electronic Device," which is a continuation patent application of U.S. patent application Ser. No. 16/826,130, filed Mar. 20, 2020, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,942,491, issued Mar. 9, 2021, which is a continuation patent application of U.S. patent application Ser. No. 14/842,617, filed Sep. 1, 2015, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,599,101, issued Mar. 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed Sep. 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. patent application Ser. No. 16/826,130, filed Mar. 20, 2020, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,942,491, issued Mar. 9, 2021 is also a continuation patent application of U.S. patent application Ser. No. 15/261,917, filed Sep. 10, 2016, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,627,783, issued Apr. 21, 2020, which is a continuation application of U.S. patent application Ser. No. 14/842,617, filed Sep. 1, 2015, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,599,101, issued Mar. 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed Sep. 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. patent application Ser. No. 16/826,130, filed Mar. 20, 2020, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,942,491, issued Mar. 9, 2021 is also a continuation patent application of U.S. patent application Ser. No. 15/261,914, filed Sep. 10, 2016, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,613,485, issued Apr. 7, 2020, which is a continuation patent application of U.S. patent application Ser. No. 14/842,617, filed Sep. 1, 2015, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,599,101, issued Mar. 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed Sep. 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. patent application Ser. No. 16/826,130, filed Mar. 20, 2020, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,942,491, issued Mar. 9, 2021 is also a continuation patent application of U.S. patent application Ser. No. 15/261,912, filed Sep. 10, 2016, and titled "Wearable Electronic Device," now U.S. Pat. No. 10,620,591, issued Apr. 14, 2020, which is a continuation patent application of U.S. patent application Ser. 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FIELD

The following disclosure generally relates to an electronic device, and more specifically to a wearable electronic device having a range of features, including touch input, force input, an interchangeable attachment system, health monitoring functionality, wireless power charging, wireless authentication and transaction functionality, and other features and functionality.

BACKGROUND

Portable electronic devices have become increasingly popular, and the features and functionality provided by portable electronic devices continue to expand to meet the needs and expectations of many consumers. However, some traditional portable electronic devices, particularly wearable electronic devices, may have relatively limited functionality or are only able to perform a specialized set of functions or

tasks. For example, some traditional electronic wristwatches may be configured to perform a relatively limited set of functions, including displaying time, date, and performing basic timing functions. The embodiments described herein are directed to a wearable electronic device that provides a wide range of functionality, as compared to some traditional wearable electronic devices.

SUMMARY

The embodiments included herein are directed to a consumer product, which may include a portable or wearable electronic device that is configured to provide an expansive feature set integrated or incorporated into a compact form factor. In some aspects of the present disclosure, a consumer product may integrate or combine multiple subsystems into a single device to provide a wide range of functionality, including biometric sensing, touch-based user input, near-field communications, and other desirable features. In some aspects, multiple subsystems are integrated into the relatively compact space of a wrist-worn device.

Some example embodiments are directed to wearable electronic device having a housing that includes a flat bottom portion, a top portion defining a cavity, and a curved side portion that extends from the bottom portion to the top portion. A band may be attached to the housing and configured to secure the wearable electronic device to a user. A display may be at least partially disposed within the cavity and may have a viewable area. The device may also include a cover disposed above the display and including a flat middle portion larger than the viewable area of the display, a curved edge portion surrounding the flat middle portion and coinciding with the curved side portion along a perimeter of the cavity to form a continuous contoured surface.

In some embodiments, the continuous contoured surface is tangent with the flat bottom portion of the housing at a first end of the contour. The continuous contoured surface may also be tangent with the flat middle portion of the cover at a second end of the contour. In some embodiments, the continuous contoured surface has a constant radius.

In some embodiments, the cavity has a rectangular shape. The curved edge portion of the housing may have four sides that surround the cavity, each side is orthogonal to two adjacent sides. Each side may be connected to an adjacent side by a rounded corner. In some embodiments, the rounded corners have a curvature that corresponds to a curvature of the continuous contoured surface formed by the curved edge portion of the cover and the curved side portion of the housing.

Some embodiments include a crown module that is positioned at least partially within an aperture formed within the curved side portion of the housing. The crown module may include an outer surface configured to receive a rotary user input. The crown module may be offset with respect to a centerline of the housing between the top portion and the flat bottom portion. The offset may be toward the top portion of the housing. The crown module may include a dial having a portion that is higher than an interface between the cover and the housing.

In some example embodiments, a port is formed in the curved side portion of the housing. An acoustic module may be disposed within the housing and configured to produce an audio output through the port. The acoustic module may include an acoustic element and an acoustic cavity that acoustically couples the acoustic element to the port. The port may include an orifice that is offset with respect to the acoustic cavity to prevent the direct ingress of liquid into the acoustic module.

In some embodiments, the device includes a gasket positioned between the housing and the cover. The housing may also include a ledge formed along a perimeter of the cavity. The gasket may be positioned along the ledge that is formed along the perimeter of the cavity. The gasket, the cover, and the housing may be configured to cooperate to form a substantially water-proof seal.

In some example embodiments, the device includes a biosensor module that is disposed in an opening formed in the flat bottom portion of the housing. The biosensor module may include a chassis positioned in the opening of the housing and defining an array of windows. An array of light sources may be attached to the chassis and configured to emit light into the user through the array of windows. The biosensor module may also include an optically transparent rear cover disposed over the chassis and over the array of windows and operative to pass light emitted from the array of light sources into the user. In some embodiments, the rear cover has a convex outer contour.

Some example embodiments are directed to an electronic device having a housing comprising a bottom portion defining an opening and a band attached to the housing and configured to secure the electronic device to a user. A biosensor module may be disposed within the opening of the housing. A rear cover may be disposed over the biosensor module and may include an edge protruding outwardly from the bottom portion of the housing and an outer surface having a convex curved contour. In some embodiments, the outer surface of the rear cover defines one or more windows that provide operational access to one or more optical components of the biosensor module. The one or more windows may have a curvature that matches the convex curved contour of the outer surface.

In some embodiments, the biosensor module includes an array of light sources that are configured to emit light into a body of the user. The biosensor module may also include a photodetector configured to receive light produced by a light source of the array of light sources that is reflected from the body and produce a sensor signal. In some cases, the biosensor module is removably coupled to the housing.

In some embodiments, the device also includes a processing unit configured to compute a health metric associated with the user based on the sensor signal. The device may also include a display disposed within the housing and configured to display the health metric.

Some example embodiments are directed to a wearable electronic device, having a housing including a top portion, a cavity formed within the top portion, and a curved side portion that surrounds the cavity. The device may also include a transparent cover disposed over the cavity of the housing and may include a flat middle portion at a center of the transparent cover, a curved outer portion that emanates from and surrounds the flat middle portion and extends outwardly to an edge of the transparent cover, and a mask positioned relative to an internal surface of the transparent cover. The mask may have an outer boundary located proximate to the edge of the transparent cover and an inner boundary located within the curved outer portion of the transparent cover.

In some embodiments, the device includes a display disposed below the transparent cover. A perimeter portion of a viewable area of the display may be disposed below the mask. The device may also include an antenna having a shape that corresponds to a shape of the cavity formed

within the housing. The antenna may be disposed in a groove formed in the internal surface of the transparent cover. The groove may be formed between the outer boundary and the inner boundary of the mask. In some embodiments, the cover is formed from a sapphire material. The antenna may be configured to facilitate wireless communication between the wearable electronic device and an external device.

Some example embodiments are directed to an electronic device having a housing including a first end, a second end opposite the first end, a first side extending between the first and second ends, and a second side opposite to the first side and extending between the first and second ends. The first end may define a first groove extending between the first and second sides and may be configured to receive a first lug portion of a first band. The second end may define a second groove extending between the first and second sides and may be configured to receive a second lug portion of a second band. The first and second grooves may have an inwardly curved concave shape with an undercut feature that retains the first and second lug portions. In some embodiments, the first groove extends through a solid portion of the housing to form a continuous interior shape.

In some embodiments, the device includes a display at least partially disposed within a cavity of the housing. A cover may be disposed above the display and at least a portion of the first groove is disposed below the cover. The first and second grooves may be formed at an angle with respect to a centerline of the housing. The first and second grooves may be angled upward toward a top of the housing and inward toward the center of the housing. The first and second grooves may cross the centerline of the housing.

Some example embodiments are directed to a wearable electronic device including a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. A crown may be disposed relative to the housing and configured to receive a rotational input. An encoder may be operatively coupled to the crown and configured to produce an encoder output that corresponds to the rotational input. A speaker module may be disposed within the housing and configured to produce an audio output that corresponds to the encoder output. A haptic device may be disposed within the housing and configured to produce a haptic output that corresponds to the encoder output. In some embodiments, the haptic output is synchronized with the audio output. The crown may be further configured to translate along an axis and actuate a tactile switch.

In some embodiments, the device also includes a display element within the housing. The device may be configured to display a list of items on the display element and scroll the list of items in response to the encoder output. The device may also be configured to synchronize the audio and haptic outputs with the scrolling of the list of items. In some embodiments, the crown is further configured to translate along an axis and actuate a tactile switch. The crown may be operative to select an item of the list of items when the tactile switch is actuated.

Some example embodiments are directed to a wearable electronic device having a housing that includes a bottom portion and an aperture formed in the bottom portion. A band may be attached to the housing and configured to secure the wearable electronic device to a user. A biosensor module may be disposed in the aperture of the housing. The biosensor module may include an array of light sources configured to emit light into a body of the user, and a photodetector configured to receive light produced by a light source of the array of light sources that is reflected from the body and produce a sensor signal. The device may also include a processing unit that is configured to compute a health metric associated with the user based on the sensor signal. A display may be disposed within the housing and configured to display the health metric.

In some embodiments, the array of light sources and the photodetector are configured to function as multiple photoplethysmography (PPG) sensors. Each PPG sensor may be configured to be used to compute a separate health metric. In some embodiments, a first light source of the array of light sources includes a green LED adapted to detect blood perfusion in the body. A second light source of the array of light sources may include an infrared LED adapted to detect water content of the body. The health metric may include one or more of: a heart rate, a respiration rate, a blood oxygenation level, and a blood volume estimate.

In some embodiments, the device also includes at least one pair of electrodes disposed on an exterior surface of the housing. The at least one pair of electrodes may be configured to produce a signal when the at least one pair of electrodes is in contact with the body. In some case, the signal is used to compute an additional health metric that includes one or more of: a heart function, a body fat estimate, and a body fat estimate.

Some example embodiments are directed to a wearable electronic device including a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. The device may also include an array of light emitting diodes (LEDs) disposed within the housing, the array of LEDs being configured to emit light. A photodetector may be disposed within the housing and configured to receive light produced by an LED of the array of LEDs that is reflected from a body of the user and produce a first sensor signal in response to the received light. The device may also include at least one pair of electrodes disposed on an exterior surface of the wearable electronic device. The electrodes may be configured to produce a second sensor signal when the electrodes are in contact with a respective portion of the body. The device may also include a processing unit that is configured to compute one or more health metrics based on the first and second sensor signals. The device may also include a display disposed at least partially within the housing and configured to display the one or more health metrics.

Some example embodiments are directed to a wearable electronic device including a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. A cover may be disposed relative to the housing and a display may be attached to a lower surface of the cover. A force sensor may be positioned between the cover and the housing and attaching the cover to the housing. The force sensor may be configured to detect the force of a touch on the cover. The force sensor may also form a barrier to prevent ingress of liquid into the wearable electronic device. In some embodiments, an antenna may be disposed relative to the cover and external from the housing. The antenna may be configured to facilitate wireless communication with an external device.

In some example embodiments, a wearable electronic device may include a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. A display element may be positioned within the housing and a rechargeable battery may be disposed within the housing and operatively coupled to the display element. The device may also include a receive coil within the housing configured to inductively couple with an external transmit coil. A power conditioning circuit may be

configured to recharge the rechargeable battery using power received by the receive coil. The power conditioning circuit may be configured to provide power to the display element. The device may also include a first alignment magnet positioned within the receive coil and configured to align the device with respect to a second alignment magnet positioned within the external transmit coil.

Some example embodiments are directed to a wearable electronic device that includes a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. A cover may be positioned relative to the housing and a display may be disposed within the housing and below the cover. A force sensor may be disposed within the housing and configured to detect a force of a touch on the cover. A touch sensor may be disposed between the display and the cover. The touch sensor may be configured to detect a location of the touch on the cover. In some embodiments, the force sensor is disposed along a perimeter of the display. The device may also include a processing unit and memory disposed within the housing. The processing unit may be configured to interpret a touch gesture on a surface of the cover using a force output from the force sensor and a touch output from the touch sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosure will be readily understood by the following detailed description in conjunction with the accompanying drawings, wherein like reference numerals designate like structural elements.

FIG. **1** depicts an example wearable electronic device having a device body and band.

FIG. **2** depicts an example schematic diagram of a wearable electronic device.

FIG. **3** depicts an example functional diagram for a wearable electronic device.

FIG. **4** depicts an example wearable electronic device as part of a system of devices.

FIG. **5** depicts a system of interchangeable components for a wearable device.

FIG. **6** depicts an example wearable electronic device having a device body and band.

FIG. **7** depicts an exploded view of components of an example wearable electronic device.

FIG. **8** depicts an example housing for a wearable electronic device.

FIG. **9** depicts an example force sensor configured to use a capacitive measurement.

FIGS. **10**A-B depict plan views of example force sensors.

FIG. **11** depicts an example force sensor configured to use a resistive measurement.

FIG. **12** depicts an example pixelated force sensor configured to use a resistive measurement.

FIGS. **13**A-B depict example force sensor structures.

FIGS. **14**A-C depict an example touch sensor based on mutual capacitance.

FIGS. **15**A-B depict an example touch sensor based on self capacitance.

FIG. **16** depicts an example device having biosensors.

FIG. **17** depicts an example device having wireless communications with an external device.

FIG. **18** depicts an example electronic device and example dock of an inductive charging system.

FIG. **19** depicts a block diagram of an example inductive charging system.

FIG. **20** depicts an example acoustic module.

FIGS. **21**A-B depict an example cover and antenna.

FIGS. **22**A-B depict an example haptic module.

FIG. **23** depicts an example device having a crown module with an encoder.

FIGS. **24**A-B depict an example device having a crown module with a tactile switch.

FIGS. **25**A-C depict an example receiving feature for a band.

FIG. **26** depicts example elements of a display.

DETAILED DESCRIPTION

Provided herein are descriptions and examples of a consumer product, which may include a portable electronic device, a wearable electronic device, or other type of device. By way of example and not by way of limitation, the consumer product may be an electronic device, a mechanical device, or an electromechanical device. Specific example devices include mobile phones, personal digital assistants, music players, timekeeping devices, health monitoring devices, tablet computers, laptop computers, glasses (electronic or otherwise), portable storage devices, and the like.

In one particular embodiment, the consumer product is a portable and, more specifically, a wearable consumer product. A wearable consumer product is one that can be worn by or otherwise secured to a user. For example, the consumer product may be a wearable electronic device including, but not limited to, a wearable computer, a wearable watch, a wearable communication device, a wearable media player, a wearable health monitoring device, and the like. A wearable consumer product may be worn by a user in a variety of ways. In some examples, the consumer product is a wrist-worn product and may include a band that can be wrapped around a user's wrist to secure the consumer product to the user's body. The device may include one or more other types of attachments including, for example, an armband, lanyard, waistband, chest strap, and the like.

Some aspects of the disclosure are directed to a wearable electronic device having improved functionality and/or versatility as compared to some traditional wearable devices. For example, some aspects of the disclosure are directed to a consumer product, such as a portable electronic device, having an expansive feature set integrated or incorporated into a compact form factor. In some aspects of the present disclosure, a consumer product may integrate or combine multiple subsystems into a single device to provide a wide range of functionality, including biometric sensing, touch-based user input, near-field communications, and other desirable features. In some aspects, multiple subsystems are integrated into the relatively compact space of a wrist-worn device. Some aspects of the following disclosure are directed to the integration of a variety of subsystems or modules to provide functionality that may not be possible using some traditional device platforms. In some cases, the configuration and/or functionality provided by the various subsystems may be configurable by the end user, the manufacturer, and/or a vendor of the device. Example subsystems or modules of a consumer product and their respective functions are described below with respect to FIGS. **2** and **3**.

Some aspects of the disclosure are directed to a consumer product that is configured to communicate wirelessly with any of a number of other devices, such as a mobile phone, computer, tablet computing devices, personal media players, televisions, networked home appliances, networked home controls, electronic systems in vehicles, and so on. Through wireless communication with other devices, the consumer product may transmit and/or receive various notifications, messages, or other information between devices. The wire-

less communication may also facilitate the relay of alerts or other device outputs to notify the user of an event or action. In some aspects, the consumer product may communicate wirelessly with any of a number of electronic accessories, including headset devices, portable speaker devices, portable microphone devices, display screens, and so on. An example communication system is described below with respect to FIG. **4** and with respect to other examples provided herein.

In some aspects, the consumer product may include a system of interchangeable components used to attach or secure the consumer product to the user. The system of interchangeable components may include a set of interchangeable bands or attachment devices that are configured to connect or attach to a receiving feature on the body of the product. The receiving feature may be standardized within the system of interchangeable components and allow multiple types of bands or attachment devices to be used with the same housing or body. The system of interchangeable components may also allow for an interchange between different bodies, which may include different types of electronic devices or other consumer products. Each body of the different devices or products may have a similar receiving feature that is standardized within the system of interchangeable components. An example system of interchangeable components is described below with respect to FIG. **5** and with respect to other examples provided herein.

Some aspects of the present disclosure are directed to a consumer product that includes a body that includes a case or housing used to protect as well as support the internal components of the product in their assembled position. The housing may enclose and support various components, including, for example, integrated circuits, subsystems, modules, and other internal components of the device. In some aspects, the housing forms a water-resistant or waterproof barrier and also provides structural rigidity necessary to protect internal components. The housing may be formed as a single piece, which may enhance the structural rigidity, water impermeability, and manufacturability of the housing. An example housing and example internal components for a consumer product are provided below with respect to FIGS. **6-8** and with respect to other examples provided herein.

In some aspects, the consumer product includes a force sensor that is configured to detect and measure the magnitude of a force or pressure on a surface of the product. In some implementations, the force sensor includes a capacitive-based sensor that is configured to estimate the force based on a deflection or movement between capacitive plates that is caused by and correlates to the amount of force caused by a touch. In some implementations, the force sensor is a resistance- or charge-based sensor that is configured to estimate the force based on the deflection of a sheet or film that is positioned relative to the touch-sensitive surface of the product. In some implementations, the output from the force sensor is combined with the output from a touch sensor, which may be self-capacitive or mutually capacitive, or a combination of the two. Example force and touch sensors are described below with respect to FIGS. **9-15**B and with respect to other examples provided herein.

In some aspects, the consumer product includes one or more biosensors. The biosensors may include optical and/or electronic biometric sensors that may be used to compute one or more health metrics. Example health metrics include, without limitation, a heart rate, a respiration rate, blood oxygenation level, a blood volume estimate, blood pressure, or a combination thereof. In some embodiments, the biosensors include an electrical sensor that may be used to measure electrocardiographic (ECG) characteristics, galvanic skin resistance, and other electrical properties of the user's body. An example consumer product having multiple biosensors is described below with respect to FIG. **16** and with respect to other examples herein.

In some aspects, the consumer product is configured to perform wireless communication with an external device. In some implementations, the wireless communication may include a Near Field Communication (NFC) interface. The NFC interface may be used to identify the device and initiate a secure data connection, which may be used to authorize transactions, purchases, or conduct other forms of e-commerce. An example consumer product having wireless communications with an external device is described in more detail below with respect to FIG. **17** and with respect to other examples herein.

In some aspects, the consumer product is configured to recharge an internal battery using a wireless charging system. In some implementations, the consumer product includes one or more receiving inductive coils that are configured to cooperate with one or more transmitting inductive coils that are located in a charging dock or other external device. The wireless charging system may allow the transfer of power and/or wireless communications with the consumer product without the use of an external port or terminal connection. An example consumer product having wireless charging capabilities is described in more detail below with respect to FIGS. **18-19** and with respect to other examples herein.

In some aspects, the consumer product includes one or more acoustic modules that are configured to function as a speaker and/or a microphone for the product. The speaker and/or microphone may include features that enhance the water/liquid resistance or impermeability of the consumer product. The consumer product may also include a haptic module or actuator that is configured to produce a haptic output that may be perceived by the user. In some implementations, the output of an acoustic module, such as a speaker, and the haptic module may be used to provide feedback or an alert to the user. In some cases, an acoustic module and the haptic module provide feedback to the user and may be coordinated with a user input, such as user-interface selecting, user-interface scrolling, or other user input command. An example acoustic module is described below with respect to FIG. **20** and an example haptic module is described below with respect to FIGS. **22**A-B.

In some aspects, the consumer product includes a dial or crown that is coupled to an encoder or other rotary sensor for detecting a rotary input. In some implementations, the output from the optical encoder is used to drive an aspect of a user interface or control other functionality of the product. Additionally, the dial or crown may include a tactile switch that can be actuated by pressing inward on the dial or crown. An example consumer product having a crown is described below with respect to FIGS. **23-24**B and with respect to other examples herein.

The description that follows includes sample devices, components, modules, systems, methods, and apparatuses that embody various elements of the present disclosure. However, it should be understood that various elements of the described disclosure may be combined and/or practiced in a variety of forms in addition to those described herein. In particular, the modules and components are described in a particular combination with respect to some examples provided below. However other combinations are possible,

which may be achieved by adding, removing, and/or re-arranging modules to obtain a device or system having the desired characteristics.

FIG. **1** depicts a wearable consumer product **10**. For example, the consumer product **10** may be a wearable electronic device. In one example, the consumer product **10** may be a wearable multifunctional electronic device including multiple functionalities such as time keeping, health monitoring, sports monitoring, medical monitoring, communications, navigation, computing operations, and/or the like. The functionalities may include but are not limited to: keeping time; monitoring a user's physiological signals and providing health-related information based on those signals; communicating (in a wired or wireless fashion) with other electronic devices or services, which may be different types of devices having different functionalities; providing alerts to a user, which may include audio, haptic, visual and/or other sensory output, any or all of which may be synchronized with one another; visually depicting data on a display; gathering data form one or more sensors that may be used to initiate, control, or modify operations of the device; determining a location of a touch on a surface of the device and/or an amount of force exerted on the device, and using either or both as input; accepting voice input to control one or more functions; accepting tactile input to control one or more functions; capturing and transmitting images; and so on. These and other functions and features will be described in more detail herein.

The wearable consumer product **10** can take a variety of forms. In one example, the consumer product **10** may be a wrist-worn electronic device. The device may include a variety of types of form factors including, wristbands, armbands, bracelets, jewelry, and/or the like.

In the illustrated embodiment, the consumer product **10** includes a device body **11**. The device body **11** may include a housing that carries, encloses and supports both externally and internally various components (including, for example, integrated circuit chips and other circuitry) to provide computing and functional operations for the consumer product **10**. The components may be disposed on the outside of the housing, partially within the housing, through the housing, completely inside the housing, and the like. The housing may, for example, include a cavity for retaining components internally, holes or windows for providing access to internal components, and various features for attaching other components. The housing may also be configured to form a water-resistant or water-proof enclosure for the body **11**. For example, the housing may be formed from as a single unitary body and the openings in the unitary body may be configured to cooperate with other components to form a water-resistant or water-proof barrier.

Examples of components that may be contained in the device body **11** include processing units, memory, display, sensors, biosensors, speakers, microphones, haptic actuators, batteries, and so on. In some cases, the device body **11** may take on a small form factor. In cases such as these, the components may be packaged and/or in order to provide the most functionality in the smallest space. The components may also be configured to take up a minimal amount of space, which may facilitate the device body **11** having a small form factor. Additionally, the integration and assembly of the various components may be configured to enhance the reliability of the consumer product **10**.

The construction of the housing of the device body **11** may be widely varied. For example, housing may be formed from a variety of materials including plastic, rubber, wood, silicone, glass, ceramics, fiber composites, metal or metal

alloys, (e.g., stainless steel, aluminum), precious metals (e.g., gold, silver), or other suitable materials, or a combination of these materials.

Also in the illustrated embodiment, the wearable electronic device includes a band **12** or strap or other means for attaching to a user. The band **12** may, for example, be configured to attach to the body and provide a loop for securing to the wrist of the user. The band **12** may be integral with the housing or it may be a separate part. If integral, the band **12** may be a continuation of the housing. In some cases, the integral band may be formed from the same material as the housing. If the band **12** is separate, the band may be fixed or releasably coupled to the housing. In both cases, the band **12** may be formed from similar or different materials as the housing. In most cases, the band **12** is formed from a flexible material such that it can conform to a user's body. Furthermore, the band **12** itself may be a single integral part or it may include attachment ends that provide an open and closed configuration. The attachment ends may, for example, be manifested as a clasp or other similar attachment mechanism or device. This particular configuration allows a user to open the band **12** for placement on the arm and close the band **12** in order to secure the band and body to the arm. The band **12** may be widely varied. By way of example, they may be formed from rubber, silicone, leather, metal, mesh, links and/or the like.

FIG. **2** depicts an example schematic diagram of a wearable electronic device. By way of example, device **100** of FIG. **2** may correspond to the consumer product **10** shown in FIG. **1**. To the extent that multiple functionalities, operations, and structures are disclosed as being part of, incorporated into, or performed by device **100**, it should be understood that various embodiments may omit any or all such described functionalities, operations, and structures. Thus, different embodiments of the device **100** may have some, none, or all of the various capabilities, apparatuses, physical features, modes, and operating parameters discussed herein.

As shown in FIG. **2**, the device **100** includes one or more processing units **102** that are configured to access a memory **104** having instructions stored thereon. The instructions or computer programs may be configured to perform one or more of the operations or functions described with respect to the device **100**. For example, the instructions may be configured to control or coordinate the operation of a display **120**, one or more input/output components **106**, one or more communication channels **108**, one or more sensors **110**, a speaker **122**, a microphone **124** and/or one or more haptic feedback devices **112**.

The processing units **102** of FIG. **2** may be implemented as any electronic device capable of processing, receiving, or transmitting data or instructions. For example, the processing units **102** may include one or more of: a microprocessor, a central processing unit (CPU), an application-specific integrated circuit (ASIC), a digital signal processor (DSP), or combinations of such devices. As described herein, the term "processor" is meant to encompass a single processor or processing unit, multiple processors, multiple processing units, or other suitably configured computing element or elements.

The memory **104** can store electronic data that can be used by the device **100**. For example, a memory can store electrical data or content such as, for example, audio and video files, documents and applications, device settings and user preferences, timing and control signals or data for the various modules, data structures or databases, and so on. The memory **104** can be configured as any type of memory. By

way of example only, the memory can be implemented as random access memory, read-only memory, Flash memory, removable memory, or other types of storage elements, or combinations of such devices.

In the schematic diagram of FIG. **2**, the one or more input components **106** are represented as a single item within the schematic diagram. However, input components **106** may represent a number of different input components, including buttons, switches, and dials for accepting user input, and so on. More specifically, the input components **106** may correspond to the buttons, dials, crowns or other devices for receiving input. Generally, the input components **106** are configured to translate a user-provided input into a signal or instructions that may be accessed using instructions executed on the processing units **102**. In the present example, the input components **106** may include the hardware configured to receive the user input (e.g., button, switch, crown, and encoder) which is operatively coupled to circuitry and firmware used to generate signals or data that are able to be accessed using processor instructions. Each input component **106** may include specialized circuitry for generating signals or data and, additionally or alternatively, circuitry and firmware for generating signals or data may be shared between multiple input components **106**. In some cases, the input components **106** produce user-provided feedback for application-specific input that corresponds to a prompt or user interface object presented on display **120**. For example, the crown (item **642** of FIG. **6**) may be used to receive rotational input from the user, which may be translated into an instruction to scroll a list or object presented on the display **120**. The input components **106** may also produce user input for system-level operations. For example the input components **106** may be configured to interact directly with hardware or firmware being executed on the device **100** for system-level operations, including, without limitation, power on, power off, sleep, awake, and do-not-disturb operations.

As shown in FIG. **2**, the device **100** may also include one or more acoustic elements, including a speaker **122** and a microphone **124**. The speaker **122** may include drive electronics or circuitry and may be configured to produce an audible sound or acoustic signal in response to a command or input. Similarly, the microphone **124** may also include drive electronics or circuitry and is configured to receive an audible sound or acoustic signal in response to a command or input. The speaker **122** and the microphone **124** may be acoustically coupled to respective ports or openings in the housing that allow acoustic energy to pass, but may prevent the ingress of liquid and other debris. As shown in FIG. **2**, the speaker **122** and microphone **124** are also operatively coupled to the processing units **102**, which may control the operation of the speaker **122** and microphone **124**. In some cases, the processing units **102** are configured to operate the speaker **122** to produce an acoustic output that corresponds to an application or system-level operation being performed on the device **100**. In some cases, the speaker **122** is operatively coupled to other modules, including, for example, input components **106**, such as a crown or button. In some implementations, the device **100** is configured to produce an audible output that corresponds to the operation of the crown or buttons using the speaker **122**. The microphone **124** may be configured to produce an output or signal in response to an acoustic stimulus. For example, the microphone **124** may be operatively coupled to the memory **104** and may be configured to record audio input, including human speech, music, or other sounds. In some cases, the microphone **124** may be configured to receive voice signals, which may be interpreted as voice commands by the processing units **102**.

The one or more communication channels **108** may include one or more wireless interface(s) that are adapted to provide communication between the processing unit(s) **102** and an external device. In general, the one or more communication channels **108** may be configured to transmit and receive data and/or signals that may be interpreted by instructions executed on the processing units **102**. In some cases, the external device is part of an external communication network that is configured to exchange data with wireless devices. Generally, the wireless interface may include, without limitation, radio frequency, optical, acoustic, and/or magnetic signals and may be configured to operate over a wireless interface or protocol. Example wireless interfaces include radio frequency cellular interfaces, fiber optic interfaces, acoustic interfaces, Bluetooth interfaces, infrared interfaces, USB interfaces, Wi-Fi interfaces, TCP/IP interfaces, network communications interfaces, or any conventional communication interfaces.

In some implementations, the one or more communications channels **108** may include a dedicated wireless communication channel between the device **100** and another user device, such as a mobile phone, tablet, computer, or the like. In some cases, output, including audio sounds or visual display elements, are transmitted directly to the other user device for output to the user. For example, an audible alert or visual warning may be transmitted to a user's mobile phone for output on that device. Similarly, the one or more communications channels **108** may be configured to receive user input provided on another user device. In one example, the user may control one or more operations on the device **100** using a user interface on an external mobile phone, table, computer, or the like.

Additionally, as described in more detail below with respect to FIG. **17**, the communications channels **108** may include a Near Field Communication (NFC) interface. The NFC interface may be used to identify the device and initiate a secure data connection, which may be used to authorize transactions, purchases, or conduct other forms of e-commerce.

As shown in FIG. **2**, the device **100** also includes one or more sensors **110** represented as a single item within the schematic diagram. However, the sensors **110** may represent a number of different sensors, including devices and components that are configured to detect environmental conditions and/or other aspects of the operating environment. Example sensors **110** include an ambient light sensor (ALS), proximity sensor, temperature sensor, barometric pressure sensor, moisture sensor, and the like. Thus, the sensors **110** may also be used to compute an ambient temperature, air pressure, and/or water ingress into the device. In some embodiments, the sensors **110** may include one or more motion sensors for detecting movement and acceleration of the device **100**. The one or more motion sensors may include one or more of the following: an accelerometer, a gyroscope, a tilt sensor, or other type of inertial measurement device.

The device **100** also includes one or more biosensors **118** and may include optical and/or electronic biometric sensors that may be used to compute one or more health metrics. As described in more detail below with respect to FIG. **16**, one or more of the biosensors **118** may include a light source and a photodetector to form a photoplethysmography (PPG) sensor. The optical (e.g., PPG) sensor or sensors may be used to compute various health metrics including, without limitation, a heart rate, a respiration rate, blood oxygenation

level, a blood volume estimate, blood pressure, or a combination thereof. One or more of the biosensors **118** may also be configured to perform an electrical measurement using one or more electrodes. The electrical sensor(s) may be used to measure electrocardiographic (ECG) characteristics, galvanic skin resistance, and other electrical properties of the user's body. Additionally or alternatively, one or more of the biosensors **118** may be configured to measure body temperature, exposure to UV radiation, and other health-related information.

The device **100** may also include one or more haptic devices **112**. The haptic device **112** may include one or more of a variety of haptic technologies such as, but not necessarily limited to, rotational haptic devices, linear actuators, piezoelectric devices, vibration elements, and so on. In general, the haptic device **112** may be configured to provide punctuated and distinct feedback to a user of the device. More particularly, the haptic device **112** may be adapted to produce a knock or tap sensation and/or a vibration sensation. As shown in FIG. **2**, the haptic device **112** may be operatively coupled to the processing unit **102** and memory **104**. In some embodiments, the haptic device **112** may be directly controlled by the processing unit **102**. In some embodiments, the haptic device **112** may be controlled, at least in part, by the operation of an input component **106**, including, for example, a button, dial, crown, or the like. The operation of the haptic device **112** may also be paired or linked to the operation of one or more other output devices, including, for example, the display **120** or the speaker **122**.

As shown in FIG. **2**, the device **100** may include a battery **114** that is used to store and provide power to the other components of the device **100**. The battery **114** may be a rechargeable power supply that is configured to provide power to the device **100** while it is being worn by the user. The device **100** may also be configured to recharge the battery **114** using a wireless charging system. Accordingly, in some cases, the device may include a wireless power module **116** that may be configured to receive power from an external device or dock. The wireless power module **116** may be configured to deliver power to components of the device, including the battery **114**. The wireless power module **116** and an external charging station or dock may also be configured to transmit data between the device and a base or host device. In some cases, the wireless power module **116** may interface with the wireless charging station or dock to provide an authentication routine that is able to identify specific hardware, firmware, or software on the device in order to facilitate device maintenance or product updates. A more detailed description of an example wireless charging station is provided below with respect to FIGS. **18-19**.

The device **100** may include a variety of other components, including for example, a camera or camera modules. The camera may be configured to capture an image of a scene or subject located within a field of view of the camera. The image may be stored in a digital file in accordance with any one of a number of digital formats. In some embodiments, the device **100** includes a camera, which includes an image sensor formed from a charge-coupled device (CCD) and/or a complementary metal-oxide-semiconductor (CMOS) device. The camera may also include one or more optical components disposed relative to the image sensor, including, for example, a lens, an filter, a shutter, and so on.

FIG. **3** depicts functional elements of the device **100**, in accordance with some embodiments. In particular, FIG. **3** depicts the inputs that may be received and outputs that may be produced on an example device **100**. By way of example, the device **100** may correspond to the devices shown in FIGS. **1** and **2**. As shown in FIG. **3**, the device **100** may include a force input **302** that may be produced using a force sensor that is configured to detect and measure the magnitude of a force of a touch on a surface of the device. The force input **302** may include a non-binary output that is generated in response to a touch. For example, the force input **302** may include a range of values or analog value that corresponds to the amount of force exerted on a surface of the device. Additionally or alternatively, the force input **302** may include binary (e.g., on, off) output in response to the force of a touch. The force input **302** may be used to control various aspects of the device. For example, the force input **302** may be used to control an aspect, such as a cursor or item selection on a user interface presented on the display of the device. The force input **302** may also be used to control the audio output **308**, haptic output **312**, and other functionality of the device. The force input **302** may also be used to distinguish between different types of input from the user. For example, a light touch from the user may be interpreted as a scroll command and used to index or scroll through a list of items on the display. A harder touch from the user may be interpreted as a selection or confirmation of an item on the display. In some embodiments, the force input **302** is used to distinguish an intentional touch from the user from an incidental or accidental touch that may be ignored.

As shown in FIG. **3**, the device **100** may also include a touch input **306** that may be produced using a touch sensor that is configured to detect and measure the location of a touch on a surface of the device. In some implementations, the touch sensor is a capacitive-based touch sensor that is disposed relative to the display or display stack of the device. The touch sensor may be a separate non-integrated sensor relative to the force sensor. In alternative embodiments, the touch sensor may also be physically and/or logically integrated with the force sensor to produce a combined output. The touch input **306** may be used to control various aspects of the device. For example, the touch input **306** may be used to control an aspect of the user interface presented on the display of the device. The touch input **306** may also be used to control the audio output **308**, haptic output **312**, and other functionality of the device.

In some cases, the logical integration of the force input **302** and the touch input **306** enhances the versatility or adaptability of device **100** by enabling a more sophisticated user interface than is currently available on some traditional wearable devices. In particular, the force input **302** and the touch input **306** may be combined to interpret a wider range of gestures and input commands than may be possible using, for example, only a touch input. For example, the force input **302** may provide a magnitude of a force of a touch, which may be used to distinguish between two touch input commands that have a similar location or gesture path. An improved touch interface using both force input **302** and touch input **306** may be particularly advantageous when interpreting touch commands on a relatively small area surface, such as a display screen or cover glass of a wearable electronic device.

As shown in FIG. **3**, the device **100** may also include a button/dial input **310** that may be produced using an input device that is configured to receive input from the user. As described previously, the device **100** may include one or more buttons disposed on or near an external surface of the housing and are configured to receive input from a user. The device may also include a dial or crown that is configured to accept rotational input from the user. As described in more

detail below with respect to FIGS. **24**A-B, the dial or crown may also include a push feature that is adapted to accept input from the user.

The device **100** may also accept audio input **314** using a microphone or other acoustic sensing device. The audio input **314** may be adapted to accept input from the user, including voice commands and other audio signal input. The audio input **314** may also be adapted to detect and measure ambient audio conditions that may be used to adjust the volume of the audio output **308** or operation of the haptic output **312**. The audio input **314** may also be used to record an audio stream or voice message in accordance with an audio recording application or software program.

As shown in FIG. **3**, the device **100** may include a display output **304** in accordance with some embodiments. The display output **304** includes visual or graphical output that may be produced using the display element of the device. In some embodiments, the display output **304** includes a graphical user interface produced using an operating system or software application executed on one or more processing units of the device. In one example, the display output **304** includes a graphical depiction that resembles a watch face or other timekeeping device. In other examples, the display output **304** includes a graphical interface for an e-mail, text messaging, or other communication-oriented program. The display output **304** may also present visual information that corresponds to one of the other functional aspects of the device **100**. For example, the display output **304** may include information that corresponds to the biosensor input **320**, sensor input **318**, force input **302**, touch input **306**, and others.

As shown in FIG. **3** the device **100** may include an audio output **308** that may be produced with a speaker or acoustic module. The audio output **308** may include sounds or audio signals that are associated with the operation of the device. For example, the audio output **308** may correspond to the operation of an input device to provide audio feedback to the user. For example the audio output **308** may correspond to an input received in the form of a force input **302**, touch input **306**, and/or button/dial input **310**. In some cases, the audio output **308** may also include a portion of an auditory alert that may be produced alone or combined with a haptic output **312** and/or display output **304** of the device **100**.

The device **100** may also include a sensor input **318** produced using one or more sensors that may be configured to monitor and detect various environmental conditions. For example, the sensor input **318** may include signals or data produced using an ambient light sensor, proximity sensor, temperature sensor, barometric pressure sensor, or other sensor for monitoring environmental conditions surrounding or near the device. In general, the sensor input **318** may be used to adapt the functionality of the device **100** to conform to the one or more environmental conditions. For example, the brightness of the display output **304**, the volume of the audio output **308**, and/or the operation of the input to the device **100** may be based on the sensor input **318**.

In some embodiments, the sensor input **318** includes input produced by one or more motion sensors. The motion sensors may include one or more of the following: an accelerometer, a gyroscope, a tilt sensor, or other type of inertial measurement device. A sensor input **318** produced using one or more motion sensors may be used to monitor and detect changes in motion of the device **100**. Changes in linear and angular motion may be used to determine or estimate an orientation of the device relative to a known location or fixed datum. The sensor input **318** produced from the one or more motion sensors may also be used to track the movement of the user. The movement of the user may be used to facilitate navigation or map-guided functionality of the device. Additionally, input related to the gross movement of the user can be used as a pedometer or activity meter, which may be stored and tracked over time to determine health metrics or other health-related information. Additionally, in some embodiments, sensor input **318** from the one or more motion sensors may be used to identify motion gestures. For example, the motion sensors can be used to detect an arm raise or the position of a user's body (within a predetermined confidence level of certainty).

The device **100** may also include a biosensor input **320** produced using one or more biosensors or biosensor modules that are configured to monitor physiological and/or health conditions of a user. As discussed above with respect to FIG. **2**, the device may include one or more optical sensors for measuring heart rate, blood pressure, oxygen saturation, or a combination thereof. The device may also include one or more sensors having electrical contacts that are disposed to contact the user's body. The sensors may be configured to measure electrocardiographic (ECG) characteristics, galvanic skin resistance, and other electrical properties of the user's body. Additionally or alternatively, sensors may be configured to measure body temperature, exposure to UV radiation, and other health related information. The biosensor input **320** may be combined with other aspects of the device to provide heath-monitoring functionality. For example, the biosensor input **320** may be used to compute data that is presented using the display output **304**. The operation of the biosensor input **320** may also be controlled using the force input **302**, touch input **306**, or other user input **310** to provide an interactive health monitoring function or application.

As shown in FIG. **3**, the device may include a haptic output **312** that may be produced using one or more haptic devices that are configured to provide haptic feedback to the user. In particular, the haptic output **312** may be produced using one or more electromechanical subassemblies that are configured to induce motion or vibration in the device, which may be perceived or sensed by the user. In some cases, the haptic actuator or device is tuned to operate based on a resonance or near resonance with respect to the device, which may enhance haptic output. In some cases, the haptic actuator or device is configured to operate based on a resonance or near resonance with respect to some components of the device, such as the band or clasp of the device.

In some embodiments, the haptic output **312** may correspond to the operation of one or more other modules or subsystems. For example, the haptic output **312** may include a vibration or haptic feedback that corresponds to an audio alert or visual alert or signal produced by the acoustic module or display, respectively. Additionally or alternatively, the haptic output **312** may be operated in conjunction with an input from the user. The haptic output **312** may include haptic or force feedback that confirms that the user input was or is being received. By way of example, a haptic output **312** may include a click or vibration when the crown of the device is turned or a button is depressed. The haptic output **312** may also be coordinated with other functionality of the device including, for example, message transmission operations, power management operations, force sensor operations, biosensor operations, to provide a notification, to provide an alert, and others.

As shown in FIG. **3**, the device **100** may also include communications input/output (I/O) **316**, which may facilitate communication with an external device or system. The communications I/O **316** may be produced using one or

more wireless interfaces, including radio frequency cellular interfaces, fiber optic interfaces, acoustic interfaces, Bluetooth interfaces, Near Field Communication interfaces, infrared interfaces, USB interfaces, Wi-Fi interfaces, TCP/IP interfaces, network communications interfaces, or any conventional communication interfaces. In some cases, the communications I/O **316** may include signals and data received from an external device that has been paired or is otherwise in electronic communication with the device **100**. The external data included in the communications I/O **316** may include, for example, message data associated with an electronic communication, notification data associated with an event, and/or data related to audio or visual content. The communications I/O **316** may also include an authorization or identification of external devices in communication with the device **100** or users associated with one or more external devices. Similarly, the communications I/O **316** may be used to output various forms of data or signals to one or more devices or systems that are external to the device **100**. For example, the communications I/O **316** may include data or computations that are produced using the biosensor input **320** and/or the sensor input **318**.

FIG. **4** depicts an example wearable electronic device **100** as part of a system of devices. By way of example, the wearable electronic device **100** of FIG. **4** may correspond to the devices shown in any of the previous figures. Generally, the wearable electronic device **100** may communicate wirelessly with any of a number of other devices, such as mobile phone **420**, computer **430**, tablet computing devices, personal media players, televisions, networked home appliances, networked home controls, electronic systems in vehicles, and so on. Additionally, the wearable electronic device **100** may communicate wirelessly with any of a number of electronic accessories, including headset devices, portable speaker devices, portable microphone devices, display screens, and so on. Communication may be through a wired or wireless connection, including any technology mentioned herein.

In some embodiments the wearable electronic device **100** may accept a variety of bands, straps, or other retention mechanisms (collectively, "bands"). These bands may be removably connected to the electronic device by a feature formed into the band or band assembly that is accepted in a recess or other aperture within the device and locks thereto. An example band interface is described in more detail below with respect to FIGS. **25**A-C.

In general, a user may change combinations of bands and electronic devices, thereby permitting mixing and matching of the two categories. It should be appreciated that devices having other forms and/or functions may include similar recesses and may releasably mate with a lug and/or band incorporating a lug. In this fashion, a system of bands and devices may be envisioned, each of which is compatible with another. A single band may be used to connect to devices, as one further example; in such embodiments the band may include electrical interconnections that permit the two devices to transmit signals to one another and thereby interact with one another.

Insofar as the electronic device **100** may connect either physically or through a data communication link with other computing devices, the combination of devices and bands may be thought of as an ecosystem having multiple parts that interact with one another, may intelligently communicate with one another, may share functionality and/or may substitute for one another in terms of operations, output, input and the like. Examples of devices existing in such an ecosystem follow, but are illustrative rather that limiting.

As one example, a number of electronic devices **100**, **420**, **430** may each have identical or similar attachment structures that permit them to share a band or connector. A user may thus change the interconnected band and device(s) with respect to one another, permitting a number of different physical connections between different ecosystem components. In some embodiments, a band that serves to retain an electronic device only may be swapped for bands having additional functionalities, such as transmitting data between devices connected to the band, adding functionality to a connected device that the device lacks, providing additional power to a connected device, and so on. Further, different bands may look different, so that the appearance of the electronic device(s) in combination with a band(s) may change by changing the band(s) and/or device(s) with respect to one another.

As another example, electronic devices **100**, **420**, **430** may communicate with one another as part of the overall ecosystem. Data may be passed from one device **420** to another 100. This may be useful if the user **410** is wearing one electronic device **100** but is not near another device **430** that wishes to notify the user or interact with the user in some fashion. Continuing the example, the computer **430** may transmit a reminder or message to the wearable device **100** to gain the user's attention. As another example, the computer **430** (or any other electronic device in the ecosystem) may transmit a state of an application or even the device itself to the wearable device **100**. Thus, for example, if an application operating on the computer needs the user's attention, it may be gained through an alert issued by the wearable device.

Data communication between devices in an ecosystem may also permit the devices to share functionality. As one non-limiting example, electronic devices may share sensor data with one another to permit one device access to data it normally would not have, from a sensor it does not physically incorporate. Thus, any given device **100**, **420**, **430** may draw on the abilities of other devices in the ecosystem to provide an enhanced and relatively seamless experience for a user **410**.

FIG. **5** depicts a system **500** of interchangeable components for a wearable device. By way of example, one or more of the devices of FIG. **5** may correspond to the devices shown in any of the previous figures. FIG. **5** depicts a system **500** including a variety of interchangeable components, including multiple device bodies **515**, **525**, **535** that are configured to connect via a standard interface to any one of a number of different bands **551***a-b*, **552***a-b*, **553***a-b*, **554***a-b*, and **555***a-b*. In addition, each of the three devices may be configured to connect via a standard interface to another type of non-band component, such as a lug **556***a-b*, non-band component, or other device.

As shown in FIG. **5**, the system **500** may include a body or device that is adapted to attach to one or more bands, straps, or other similar component that may be used to attach the device to the body of a user. In some embodiments, the device may be interchangeable or interchanged to provide a different set of functions or features. In some embodiments, the bands or attachment components may be interchangeable or interchanged to provide desired functionality or features.

In the example depicted in FIG. **5**, each of the devices includes at least one receiving feature **504** that is configured to interconnect with a corresponding feature **502** that is attached to or integrally formed with the end of each of the bands or other mating parts. In some embodiments, receiving feature **504** includes a channel or groove that is formed in one end of the device body. The mating feature **502** of a

respective band or component may be configured to slidably engage with the receiving feature **504** of a respective device body to attach the band or component. An example receiving feature is described in more detail below with respect to FIGS. **25**A-C. In some embodiments, the receiving feature **504** and the mating feature **502** are standardized in the system **500** and, thus, any of the bands (**551***a-b*, **552***a-b*, **553***a-b*, **554***a-b*, and **555***a-b*) can be interchangeably used with any of the device bodies **515**, **525**, **535**.

With respect to FIG. **5**, each of the bands may be formed from a different material or using a different construction. In the present example, bands **551***a-b* may be formed from a textile material that may be constructed from a pattern of thread or fiber material. The textile material may include a variety of materials, including natural fibers, synthetic fibers, metallic fibers, and so on. The bands **552***a-b* may be formed from a woven material and may be constructed from an array of warp fibers or threads interwoven with one or more weft fibers or threads. Similarly, the warp and weft fibers may include a variety of materials, including natural fibers, synthetic fibers, metallic fibers, and so on. The bands **553***a-b* may be formed from leather material **553***a-b*. In one example, the bands **553***a-b* are formed from a sheet or strip of cowhide; however, the bands **553***a-b* may also be formed from one of any number of types of animal hide. The leather material **553***a-b* may also include a synthetic leather material, such as vinyl or plastic. The bands **554***a-b* may be formed from a metallic mesh or link construction. For example the bands **554***a-b* may be formed from a Milanese mesh or other similar type of construction. The bands **555***a-b* may be formed from a silicone or other elastomer material.

In some cases, the band is a composite construction including various materials, which may be selected based on the end use or application. In some embodiments, a first band strap, or a first portion of the first band strap, may be made up of a first material and a second band strap, or a second portion of the second band strap, may be made from a second, different material. The band may also be made up of a plurality of links and, as such, the band may be resizable by, for example, adding or removing links. Example bands and band constructions are provided below in Section **12**.

In the system **500**, an interchangeable band may allow for individual customization of the device or to better adapt the device for a range of uses or applications. In some instances, the type of band that is selected and installed can facilitate a particular user activity. For example, band **551***a-b* may be formed from a textile material and include a durable clasp that may be particularly well suited for exercise or outdoor activities. Alternatively, as discussed above the band **554***a-b* may be formed from a metallic material and include a thin or low-profile clasp that may be well suited for more formal or fashion-focused activities.

In some embodiments, the band may be coupled to a separate component having the mating feature **502**. The band may be coupled using pins, holes, adhesives, screws, and so on. In yet other embodiments, the band may be co-molded or overmolded with at least a portion of the component having the mating feature **502**. In some embodiments, the band is coupled to the component via a pin that allows the straps to rotate with respect to the component. The pin may be formed integrally with or disposed in a loop formed in the end of the band.

In the example system **500**, each of the bands is shown as having a generic band clasp. However, the type of band clasp that is used may vary between embodiments. On example band clasp may include a first band strap having a buckle or tang assembly which is configured to interface with a second band strap having a series of apertures or holes formed with the strap. Additionally or alternatively, the bands may include a magnetic clasp having one or more magnetic elements on a first band strap that is configured to mate to one or more magnetic or ferromagnetic elements on a second band strap.

As shown in FIG. **5**, the system may include multiple device bodies **515**, **525**, **535** that may vary in size, shape, and composition. The device body **515**, **525**, **535** may include one or more of the embodiments described herein and may include, but is not limited to a wearable computer, a wearable watch, a wearable communication device, a wearable media player, a wearable health monitoring device, and/or the like. In particular, the device body may correspond to the device body described with respect to device body **610** of device **100** (shown in FIG. **6**).

1. Example Wearable Electronic Device

FIG. **6** depicts an example wearable electronic device, which may include various aspects of the device(s) described above. In some embodiments, multiple modules or subsystems are physically and operationally integrated together to provide particular functionality or device features. In particular, the interaction between the subsystems, or the subsystems themselves, may be configurable by the user, manufacturer, or vendor to adapt the device to produce certain functionality. Some example combinations and interactions between the various modules and subsystems are expressly provided in the present description. However, the combinations and interactions provided herein are merely illustrative in nature and are not intended to be limiting on the scope of the disclosure.

FIG. **6** depicts an example configuration of a wearable electronic device **100**. In particular, FIG. **6** depicts an electronic wearable device **100** including a device body **610** that may be configured to be attached to the wrist of a user using a band assembly **620**. This configuration may also be referred to herein as a wearable device, a device, an electronic wristwatch, or an electronic watch. While these terms may be used with respect to certain embodiments, the functionality provided by the example electronic wearable device **100** may be substantially greater than or vary with respect to many traditional electronic watches or timekeeping devices.

In the present example, the exterior surface of the device body **610** is defined, in part, by the exterior surface of the housing **601** and the exterior surface of the cover **609**. In the example depicted in FIG. **6**, the device body **610** is substantially rectangular with round or curved side portions. The outer surfaces of the cover **609** and the housing **601** coincide at a joint interface and cooperate to form a continuous contoured surface. The continuous contoured surface may have a constant radius and may be tangent to a flat middle portion of the cover **609** and/or a flat bottom portion of the housing **601**. In some embodiments, the cover **609** has substantially the same shape as a flat bottom portion and at least a portion of the curved side portions of the housing **601**. A more complete description of the geometry of the cover **609** and the housing **601** is provided below with respect to FIGS. **7** and **8**.

In the example of FIG. **6**, the device **100** includes a display (item **120** of FIG. **2**) that is disposed at least partially within an opening or cavity defined within a top portion of the housing **601** of the device body **610**. The display may be formed from a liquid crystal display (LCD), organic light

emitting diode (OLED) display, organic electroluminescence (OEL) display, or other type of display device. The display may be used to present visual information to the user and may be operated in accordance with one or more display modes or the software applications being executed on the device **100**. By way of example, the display may be configured to present the current time and date similar to a traditional watch or timepiece. The display may also present a variety of other visual information that may correspond to or be produced using one of the other modules in the device **100**. For example, the display may be configured to display one of a variety of notification messages, which may be generated based on data received from the one or more sensors, the wireless communication system, or other subsystem of the device **100**. The display may also be configured to present visual information or data that is based on the output of one or more sensor outputs. The display may also provide status or information related to a wireless charging process or battery power. The display may also present visual output or information related to media being produced using a speaker or acoustic module of the device **100**. Accordingly, a variety of other types of visual output or information may be presented using the display.

In the current example, the display includes or is integrated with a cover **609** that helps to protect the display from physical impact or scratches. In the field of wearable devices, the cover **609** may also be referred to generically as a crystal or cover glass, regardless of the material that is used to form the cover **609**. In some cases, the cover **609** is formed from a sheet or block of sapphire material. Sapphire may provide superior optical and surface hardness properties as compared to other materials. In some cases, the sapphire material has a hardness of approximately 9 on the Mohs scale. In alternative embodiments, the cover **609** is formed from a glass, polycarbonate, or other optically transparent material. The cover **609** may also be coated with one or more optical or mechanical enhancing materials or surface treatments. For example, interior and/or exterior surfaces of the cover **609** may be coated with an anti-reflective (AR), oleophobic or other coating to enhance the visible or functional properties of the display. Additionally, in some cases, the cover **609** may be configured to cooperate with an antenna used to facilitate wireless communication with an external device. FIGS. **21**A-B, described in more detail below, provide one example embodiment of a cover configured to cooperate with an antenna.

In the example depicted in FIG. **6**, the cover **609** is formed from a transparent material and, when assembled has an external surface and an internal surface. The cover **609** is disposed above the display and encloses a cavity or opening formed in the top portion of the housing **601**. In some embodiments, the external surface of the cover **609** cooperates with the external surface of the housing to form a substantially continuous external peripheral surface of the electronic device. As shown in FIG. **6**, the external surface of the cover **609** has a flat middle portion at the center of the cover, which extends outwardly. The cover **609** also includes a curved edge portion that emanates from and surrounds the flat middle portion and extends outwardly to an edge at the side of the cover **609**. In some embodiments, the cover **609** also includes an opaque mask disposed relative to the internal surface of the transparent cover. The opaque mask may correspond to or otherwise define the viewable area of the display **120**. The mask may have an outer boundary that is located proximate the edge of the side of the cover **609** and has an inner boundary located within the curved edge portion of the cover **609**.

As shown in FIG. **6**, the cover **609** is disposed relative to a top portion of the housing **601**. The housing **601** includes a top portion defining an opening, which is surrounded by a curved side portion. In the present example, the curved edge portion of the cover **609** coincides with the curved side portion of the housing **601** to form a continuous external surface of the electronic device **100**. In some instances, the cover **609** may have a contour that follows or otherwise corresponds to a similar contour of the housing **601** to form a substantially continuous surface at the interface between the two components. As shown in FIG. **6**, the cover **609** protrudes above the housing **601**.

In some instances, the cover **609** is disposed relative to a touch sensor (item **702** of FIG. **7**). In some embodiments, the touch sensor may be integrated with the display or other element of the device **100**. The touch sensor may be formed from one or more capacitive sensor electrodes or nodes that are configured to detect the presence and/or location of an object or the user's finger that is touching or nearly touching the surface of the display. In some cases, the touch sensor includes an array of sensing nodes formed in accordance with a mutual capacitance sensing scheme.

In one example, the touch sensor may include an array of mutual capacitance touch nodes that can be formed by a two-layer electrode structure separated by a dielectric material. One layer of electrodes may comprise a plurality of drive lines and another layer of electrodes may comprise a plurality of sense lines, and where the drive lines and the sense lines cross, mutual capacitive sense nodes are formed (also referred to as coupling capacitance). In some implementations, the drive lines and sense lines may cross over each other in different planes separated from one another by a dielectric. Alternatively, in other embodiments the drive lines and sense lines can be formed substantially on a single layer. An example touch sensor and touch-sensing node are described in more detail below with respect to FIGS. **14**A-C and **15**A-B.

Alternatively or additionally, the touch sensor may include one or more self-capacitive nodes or electrodes that are configured to detect a discharge of electrical current or charge when an object, such as a user's finger, contacts or nearly contacts a surface of the housing **601** or other surface of the device **100**. Other types of electronically sensing nodes, including resistive, inductive, or the like, may also be integrated into a surface of the device **100**.

In some embodiments, the device **100** may also include a force sensor (item **705** of FIG. **7**). The force sensor may be disposed relative to the display **120** or integrated with other elements of the device **100**. In some cases, the force sensor includes one or more force sensing structures or force-sensing nodes for detecting and measuring the magnitude of a force or pressure due to a touch on a surface of the device **100**. The force sensor may be formed from or implement one or more types of sensor configurations. For example, capacitive and/or strain based sensor configurations may be used alone or in combination to detect and measure the magnitude of a force or pressure due to a touch. As described in more detail below, a capacitive force sensor may be configured to detect the magnitude of a touch based on the displacement of a surface or element on the device. Additionally or alternatively, a strain-based force sensor may be configured to detect the magnitude of a touch based on the deflection. Example force sensor and force-sensing modules are described in more detail below with respect to FIGS. **9-12**.

As shown in FIG. **6**, the device **100** also includes device body **610** including a housing **601** that upon which may be mounted or integrated with various components of the

device **100**. The housing **601** serves to surround at a peripheral region as well as support the internal components of the product in their assembled position. In some embodiments, the housing **601** may enclose and support internally various components (including for example integrated circuit chips and other circuitry) to provide computing and functional operations for the device **100**. The housing **601** may also help define the shape or form of the device. That is, the contour of the housing **601** may embody the outward physical appearance of the device. As such, it may include various ornamental and mechanical features that improve the aesthetical appearance and tactile feel of the device. For example, the housing **601** may include a contoured surface that includes rectilinear contours, curvilinear contours, or combinations thereof. The housing **601** may also include various surface features, including textures, patterns, decorative elements, and so on.

In the present example, the housing **601** is formed from a single piece, which may also be referred to as single-body, unitary, or uni-body design or construction. By utilizing a single-body construction, the structural integrity of the device may be improved as compared to a multi-piece construction. For example, a single body may be more easily sealed from contaminants as compared to a multi-piece enclosure. Additionally, a single-body enclosure may be more rigid due, in part, to the absence of joints or seams. The rigidity of the housing **601** may be further enhanced by increasing the material thickness in areas where mechanical stress may be greatest, while also maintaining or thinning other areas where mechanical stress may be lower or reduced. Variations in the thickness of the housing **601** may be possible by machining or casting the housing **601** as a single piece. Additionally, a single-body housing **601** may include one or more features for mounting or integrating the internal components of the device **100**, which may facilitate manufacturing and/or assembly of the device **100**.

An example housing **601** is described in more detail below with respect to FIG. **8**. The housing **601** may be formed from a variety of materials, including, without limitation plastic, glass, ceramics, fiber composites, metal (e.g., stainless steel, aluminum, magnesium), other suitable materials, or a combination of these materials. Further, the housing **601** may include a surface treatment or coating, which may be formed from a variety of materials, including, without limitation aluminum, steel, gold, silver and other metals, metal alloys, ceramics, wood, plastics, glasses, and the like.

As discussed above, the display, the touch sensor, and force sensor may be disposed within the housing **601**. In this example, one or more buttons **644** and a crown **642** used to receive user input may also be disposed within or relative to the housing **601**. Other types of user input, including for example, one or more dials, slides, or similar user input devices or mechanisms may also be disposed within or relative to the housing **601**. As described in more detail with respect to FIGS. **7** and **8**, the housing **601** may include various features for attaching and mounting the subassemblies and modules of the device **100**. In particular, the housing **601** may have one or more openings for receiving the cover **609**, the display, the force sensor, or other components. The housing **601** may also include one or more holes or openings for receiving the button **644** and crown **642** that are located around the perimeter of the device **100**. In some embodiments, the housing **601** also includes internal features, such as bosses and threaded portions, that can be used to attach modules or components within the housing **601**.

The device **100** may also include an ambient light sensor (ALS) that is configured to detect and measure changes in ambient lighting conditions. The ALS may include a photodiode and one or more optical elements or lenses for collecting light. An ALS may be located on an external facing surface that is less likely to be blocked when the device is worn or in use. The ALS may be used to adjust settings, including screen brightness and other visual output depending on the overall lighting conditions.

The housing **601** may also include one or more motion-sensing elements or devices for detecting motion of the device **100**. For example, the device **100** may include one or more accelerometers that are configured to sense acceleration or changes in motion. Additionally or alternatively, the device **100** may include one or more gyroscopic sensors that are configured to detect changes in direction. In some cases, the one or more gyroscopic sensors may include a spinning mass that can be used to detect changes in angular velocity. Multiple motion-sensing elements may be used to detect motion along multiple directions or axes. The motion sensors may also be used to identify motion gestures. For example, the motion sensors can be used to detect an arm raise or the position of a user's body (within a predetermined confidence level of certainty). The one or more motion-sensing elements may be used to determine an orientation of the device relative to a known or fixed datum. For example, the device may include a compass and/or global positioning system (GPS) that can be used to identify an absolute position. The one or more motion sensing elements may then measure deviation or movement with respect to the absolute position to track movement of the device or the user wearing the device. In some implementations, the one or more motion-sensing elements are used to detect gross movement of the device or user. The gross movement may be used as a pedometer or activity meter, which may be tracked over time and used to calculate a health metric or other health-related information.

Described in more detail with respect to FIG. **8**, the housing **601** may also include one or more openings or orifices coupled to an acoustic module or speaker **122**, which may include a speaker and/or a microphone subassembly. Although the housing **601** may include one or more openings or orifices, the housing **601** may still be substantially waterproof/water resistant and may be substantially impermeable to liquids. For example, the opening or orifice in the housing or enclosure may include a membrane or mesh that is substantially impermeable to liquid ingress. Additionally or alternatively, the geometry of the opening or orifice and other internal features of the housing **601** may be configured to reduce or impede the ingress of liquid or moisture into the device **100**. In one example, the opening is formed from one or more orifices that are offset with respect to an internal acoustic chamber or cavity, which may prevent a direct path from the outside of the housing **601** into the acoustic module.

As shown in FIG. **6**, the device **100** includes a device body **610** that may be attached to a user's wrist using a band **620**. In the present example, the band **620** include a first band strap **621** attached to a first receiving feature **623** and a second band strap **622** attached to a second receiving feature **624**. In some embodiments, the first and second band straps **621**, **622** include a lug feature that is configured to attach to the first and second receiving features **623**, **624**, respectively. As shown in FIG. **6**, the free ends of the band straps **621**, **622** are connected with a clasp **625**.

The band straps **621**, **622** are formed from a flexible or compliant material that may be specially configured for a

particular application. The band straps **621**, **622** may be formed from a variety of materials, including, for example, leather, woven textiles, or metallic mesh materials. The material and construction of the band straps **621**, **622** may depend on the application. For example, the band straps **621**, **622** may be formed from a woven textile material configured for exposure to impact and moisture typically associated with outdoor activities. In another example, the band straps **621**, **622** may be formed from a metallic mesh material that may be configured to have a fine finish and construction that may be more appropriate for professional or social activities.

Similarly, the clasp **625** of the band **620** may be configured for a particular application or to work with a particular style of band. For example, if the band straps **621**, **622** are formed from a metallic mesh material, the clasp **625** may include a magnetic clasp mechanism. In the present example, the device **100** is configured to be attached to the wrist of a user. However, in alternative embodiments, the device may be configured to be attached to the arm, leg or other body part of the user.

The housing **601** includes one or more features for attaching the band straps **621**, **622**. In the present example, the housing **601** includes a first receiving feature **623** and a second receiving feature **624** for attaching the first band strap **621** and the second band strap **622**, respectively. In this example, the band straps **621**, **622** include a lug portion that is adapted to mechanically engage with the receiving features **623**, **624**. A more detailed description of the receiving features and lugs is provided below with respect to FIGS. **25**A-C. As shown in FIG. **6**, the first **623** and second receiving features **624** may be integrally formed into the housing **601**. In alternative embodiments, the receiving features may be formed from separate parts and may be attached to the housing **601** during manufacturing. In some embodiments, the receiving features **623**, **624** may be configured to release the band straps **621**, **622** from the device body **610** (e.g., the housing **601**). For example, one or both of the receiving features **623**, **624** may include a button or slide, which may be actuated by the user to release a corresponding band strap **621** and **622**. One advantage of a releasable lug is that the user can swap between a variety of bands that may be specially configured for a particular use scenario. For example, some bands may be specially configured for sport or athletic activities and other bands may be configured for more formal or professional activities.

The device **100** may also include a rear cover **608** located on the rear-facing surface of the housing **601** of the device body **610**. The rear cover **608** may improve the strength and/or scratch resistance of the surface of the device **100**. For example, in some embodiments, the rear cover **608** may be formed from a sapphire sheet, zirconia, or alumina material having superior scratch resistance and surface finish qualities. In some cases, the sapphire material has a hardness greater than 6 on the Mohs scale. In some cases, the sapphire material has a hardness of approximately 9 on the Mohs scale. Due to the superior strength of the sapphire material, a cover glass formed from a sapphire sheet may be very thin. For example, the thickness of a sapphire cover sheet may be less 300 microns thick. In some cases, the thickness of a sapphire cover sheet may be less than 100 microns thick. In some cases, the thickness of a sapphire cover sheet may be less than 50 microns thick. In some embodiments, the rear cover **608** is contoured in shape. For example, the rear cover **608** may have a convex curved surface.

FIG. **7** depicts an example exploded view of various modules and subassemblies of the device **100**. As shown in FIG. **7**, multiple components are configured to be disposed within and/or attached to the housing **601**. The exploded view provided in FIG. **7** depicts one example arrangement of the components of the device **100**. However, in other embodiments, arrangement, placement, and/or grouping of the subassemblies and the components of the subassemblies may vary.

In the present example, a main cavity of the housing **601** houses an electronics subassembly **720** and the battery **114** of the device. The electronics subassembly **720** includes one or more electrical circuit assemblies for coupling the various electrical components of the device **100** to each other and to power supplied by the battery **114**. The electronics subassembly **720** may also include structural elements or components that provide structural rigidity for the electronics subassembly **720** and/or structural mounting or support for other components disposed within the housing **601**. As shown in FIG. **7**, within the cavity of the housing **601**, the speaker **122**, the crown module **642**, and the battery **114** are all disposed above the electronics subassembly **720**. In the present embodiment the top surface of the speaker **122**, the crown module **642**, and the battery **114** have a substantially similar height. In some embodiments, the speaker **122**, the crown module **642**, and the battery **114**, when assembled in the housing **601**, define an area for the display **120** within the cavity. Thus, as shown in FIG. **7**, the display **120** may overlay the speaker **122**, the crown module **642**, and the battery **114**, which overlay the electronics subassembly **720**.

As shown in FIG. **7**, the cover **609** is configured to fit within a corresponding recess formed within the housing **601**. In particular, the cover **609** includes a vertical portion having a height that corresponds to the depth of the recess formed within the housing **601**. In this example, the device **100** includes a force sensor **705** disposed between the housing **601** and a cover subassembly **704**. As described in more detail below with respect to FIGS. **9** and **10**A-B, the force sensor **705** may be configured to detect a force placed on a surface of the cover **609** by detecting a relative deflection between the cover **609** (or cover subassembly **704**) and the housing **601**. In the present example, the force sensor **705** also forms a gasket or seal between the cover subassembly **704** and the housing **601**. In some implementations, the seal is a water-proof or water-resistant seal that helps to prevent water or liquid ingress into the internal cavity of the housing **601**. The force sensor **705** may also be used to join the cover subassembly **704** to the housing **601** using an adhesive or film.

In some embodiments, the cover subassembly **704** includes the cover **609** which is disposed above the touch sensor **702** and display **120**. In the present example, the touch sensor **702** and the display **120** are attached to each other by an optically clear adhesive layer (OCA). Similarly, an OCA layer is used to attach the touch sensor **702** to the cover **609**. Other adhesives or bonding techniques may be used to attach the display **120** and the touch sensor **702** to the cover **609**. In some embodiments, the touch sensor **702** is integrated into the display **120** and the display **120** (and integrated touch sensor **702**) are attached to the cover **609**.

As shown in FIG. **7**, the speaker **122** is also disposed within the cavity of the housing **601**. The speaker **122** is adapted to mechanically and acoustically interface with a port formed in the side of the housing **601**. In some embodiments, the port is configured to prevent a direct path for water or liquid into an acoustic chamber or cavity of the speaker **122**. In some embodiments, the device **100** also includes a microphone that is similarly coupled to another port formed in the side of the housing **601**. A more detailed

description of the speaker **122** and microphone is provided below with respect to the acoustic module of FIG. **20**.

In the present example, the haptic device **112** is also disposed within the cavity of the housing **601** proximate to the speaker **122**. In some embodiments, the haptic device **112** is rigidly mounted to a portion of the housing **601**. A rigid mounting between the housing **601** and the haptic device **112** may facilitate the transmission of vibrations or other energy produced by the haptic device **112** to the user. In the present example, the haptic device **112** includes a moving mass that is configured to oscillate or translate in a direction that is substantially parallel with a rear face of the housing **601**. In some implementations, this orientation facilitates the perception of a haptic output produced by the haptic device **112** by a user wearing the device **100**. While this configuration is provided as one example, in other implementations, the haptic device **112** may be placed in a different orientation or may be configured to produce a haptic response using a rotating mass or other type of moving mass.

As shown in FIG. **7**, the device also includes an antenna subassembly **722**. In this example, a portion of the antenna subassembly **722** is disposed within the housing **601** and a portion of the antenna subassembly **722** is disposed within the cover assembly. In some implementations, a portion of the antenna subassembly **722** is disposed relative to a feature formed within the cover **609**. An example embodiment is described in more detail below with respect to FIGS. **21**A-B.

In the example depicted in FIG. **7**, the device **100** also includes a crown module **642** which is disposed in an aperture or hole in the housing **601**. When installed, a portion of the crown module **642** is located outside of the housing **601** and a portion of the crown module **642** is disposed within the housing **601**. The crown module **642** may be configured to mechanically and/or electrically cooperate with the electronics subassembly **720**. A more detailed description of an example crown module is provided below with respect to FIGS. **23** and **24**A-B. The housing **601** also includes a button **644**, which is disposed in an opening of the housing **601** and may be configured to mechanically and/or electrically cooperate with the electronics subassembly **720**.

In the example depicted in FIG. **7**, a biosensor module **710** is disposed in an opening formed in the rear surface of the housing **601**. In some embodiments, the biosensor module **710** includes the rear cover **608** and may also include a chassis or plate that facilitates attachment of the biosensor module **710** to the housing **601**. The chassis or plate or the cover sheet **608** may also include features or elements that facilitate a watertight seal between the biosensor module **710** and the housing **601**. For example, the rear cover **608** may include a shelf or flange that may be used to form a seal between the biosensor module **710** and the housing **601**. As described in more detail below with respect to FIG. **16**, the biosensor module **710** may include one or more light sources, one or more photodetectors, and one or more electrodes or conductive elements that are configured to detect and measure a physiological condition or property of the user.

In some embodiments, the rear cover **608** has an edge that protrudes outwardly from the back surface of the housing **601**. The rear cover **608** may also have a convex curved area located between the edges of the rear cover **608**. The convex curved area of the rear cover **608** may include one or more windows or apertures that provide operational access to one or more internal components located within the housing **601**. In some embodiments, the windows have a curvature that matches the curvature of the convex curved area of the rear cover.

2. Example Housing

As described above, a wearable electronic device may include a device body that includes a housing or enclosure shell. As previously described, the housing may function as a chassis that physically integrates the various components of the device. The housing may also form a protective shell or housing for the components and function as a barrier against moisture or debris. In the present examples, the housing is formed as a uni-body, unitary, or single body or component. A single-body construction may be advantageous by providing mounting features directly into the housing, which may reduce space, reduce part count, and increase structural rigidity as compared to some alternative configurations. Additionally, a single-body construction may improve the housing's ability to prevent the ingress of moisture or debris by reducing or eliminating seams or joints between external components.

FIG. **8** depicts an example housing **601** in accordance with some embodiments. In the present example, the housing **601** is formed as a single body or component. As shown in FIG. **8**, the housing **601** is formed as a single part or body. The housing **601** may be formed, for example, by machining or shaping a solid or cast blank having the approximate shape of the housing **601**. In some implementations, the housing **601** may be configured to provide structural integrity for potentially delicate internal components and also withstand a reasonable impact.

In the present embodiment, the housing **601** is formed as a uni-body, unitary, or single-body construction having a flat bottom portion **801** and a top portion including flange **812**. The top portion defines an internal cavity **805**, which is surrounded by four sides **802***a-d* that are integrally formed with the bottom portion **801**. The internal cavity **805** can also be described as being defined by the top portion, the four sides **802***a-d* and the bottom portion **801**. In this example, the internal cavity **805** has a rectangular (square) shape, although the specific shape may vary with different implementations. In the present example, the four sides **802***a-d* define a curved side portion of the housing **601** that extends from the bottom portion **801** to the top portion of the housing **601**. Each side **802***a-d* is orthogonal to an adjacent side and each side **802***a-d* is connected to an adjacent side by a rounded corner. For example, side **802***a* is orthogonal to two adjacent sides **802***b* and **802***d* and is connected to those sides by respective rounded corners. The shape or contour of the rounded corners may correspond to the curvature of the curved portion of the housing **601**. Specifically, the curvature of the rounded corners may match or correspond to the curvature of the continuous external surface formed by the housing **601** and the cover **609**, as described above with respect to FIG. **6**.

The sides **802***a-d* may vary in thickness in order to provide the structural rigidity for the device. In general, areas of high stress may have an increased material thickness as compared to areas of low stress, which may have a reduced material thickness. In particular, portions of the sides **802***a-d* near the bottom portion **801** may have an increased thickness as compared to portions of the sides **802***a-d* located further away from the bottom portion **801**. This configuration may improve the structural rigidity and overall stiffness of the housing **601**.

As shown in FIG. **8**, one or more mounting features may be formed directly into the housing **601**, which may reduce the number of parts and also enhance the structural integrity of the device. As shown in FIG. **8**, receiving features **623**, **624** may be formed as channels or openings that are configured to receive an end of a band (e.g., a lug) having a mating feature. As described above with respect to FIG. **5**, the receiving features **623**, **624** may be standardized and configured to work with a system of interchangeable components. Forming the receiving features **623**, **624** directly into the housing **601** may reduce parts and also facilitate structural rigidity of the device.

In the example depicted in FIG. **8**, the housing **601** can be described as having two ends (a first end and a second end opposite the first end), and a first side and a second side opposite the first side, the sides being continuous with the ends. In this example, the first and second ends and the first and second sides having an outwardly curved three-dimensional shape. In this example, the receiving feature **623** is formed from a first groove situated in the first end. Similarly, the receiving feature **624** is formed from a second groove situated in the second end. In the present example the grooves have openings at the interface of the first and second sides and first and second ends. As shown in FIG. **8** the groove also has an inwardly curved concave three-dimensional shape with an undercut feature. For example, the middle portion of the groove of receiving features **623**, **624** may have a width that is greater than the opening of the receiving features **623**, **624**. In some embodiments, the upper portion of the housing overhangs the lower portion of the housing at the groove opening. In the example depicted in FIG. **8**, the groove is cut into a solid portion of the housing such that the groove forms a continuous interior shape.

The geometry of the receiving features may be located with respect to other features or components of the device. In the example depicted in FIG. **8**, at least a portion of the groove of the receiving features **623**, **624** may be disposed underneath the cover (item **609** of FIGS. **6-7**). With respect to FIG. **6**, the groove of the receiving features **623**, **624** is located underneath the opening for the cover, which is defined by the sealing ledge **810** and flange **812** formed in the upper portion of the housing **601**. In some embodiments, the length of the groove extends further than the width of the opening configured to receive the cover (and thus the cover, when assembled). In some embodiments, the grooves are formed at an angle relative to the centerline of the housing. In some cases, the angle is approximately 5 degrees. In some embodiments, the groove is located underneath the centerline of the housing **601**. In some embodiments, the groove is angled upward toward the top of the housing **601** and inward toward the center of the housing **601**. The groove **601** may angle upward and cross the centerline of the housing. In some cases, the groove crosses the vertical centerline of the housing **601**.

In the present embodiment, the housing **601** also includes an aperture **821** formed into the side **802***c* of the housing **601** for attaching a crown or crown module (item **642** of FIGS. **6-7**). In some embodiments, the aperture **821** for the crown is offset upwardly from the centerline of the housing **601**. In some embodiments, the aperture **821** for the crown is positioned such that an upper portion of a crown (when installed) is higher than the interface of cover **609** and housing **601**. With respect to FIG. **6**, the interface may correspond to the upper edge of the flange **812**.

The housing **601** also includes an opening **822** formed into the side **802***c* of the housing **601** for attaching the button (item **644** of FIGS. **6-7**). In some embodiments, the aperture **821** for the crown and the opening **822** for the button are disposed with the length defined by a flat part of the cover. In some embodiments, the aperture **821** for the crown is disposed above the centerline of the housing **601** and the opening **822** for the button is disposed below the centerline of the housing **601**. In some embodiments, the aperture **821** for the crown and the opening **822** for the button are disposed on a curved surface of the housing **601**. The housing **601** may also include various other internal features, including threaded features and bosses, for attaching other internal components of the device.

In some cases, the housing **601** may be formed as a single-piece or integral enclosure shell to enhance the structural rigidity and/or liquid-sealing properties of the device. As described above with respect to FIGS. **6** and **7**, the housing **601** may be integrated with a cover (e.g., crystal) and other external components to provide a substantially sealed housing. In the present embodiment, the housing **601**, includes a sealing ledge **810** formed around the perimeter of the main cavity **805** formed within the housing **601**. In some embodiments, the sealing ledge **810** (and thus the cover when installed) is located in the center of the housing **601**. The sealing ledge **810** may be defined by a substantially flat portion **811** that is adapted to form a seal between the housing **601** and another component (e.g., the force sensor **705** or cover **609** of FIGS. **6-7**). The sealing ledge **810** may be formed at a depth that is substantially similar or corresponds to the thickness of the mating cover.

As shown in FIG. **8**, the sealing ledge **810** may also include flange **812** that protrudes from the flat portion and forms a continuous surface with the side walls **802***a-d*. In some cases, the flange **812** is configured to cooperate with the cover (item **609** of FIGS. **6-7**) to form a substantially continuous surface. In some implementations, the sides **802***a-d* and the cover or crystal are configured to cooperate or mechanically interface to improve the strength and the water sealing properties of the device.

As also shown in FIG. **8**, an opening or aperture **815** may be formed in the bottom portion **801** of the housing **601**. In some embodiments, the opening or aperture **815** is located at the center of the housing **601**. As described above with respect to FIG. **7**, the aperture **815** may be used to integrate a sensor array or other module used to collect measurements that may be used to compute a health metric or other health-related information. The present embodiment may be advantageous by integrating multiple components in a single opening **815**, which may facilitate a water-proof or water-resistant property of the device. Additionally, by integrating a sensor array into a module that attaches via the opening **815**, same housing **601** may be used with a variety of sensing configurations or arrays. For example, the number or sensors or components may be increased or decreased without modifying the housing **601**. This may allow for flexibility in the product development and may facilitate upgrades as new sensing configurations are available.

As previously discussed above with respect to FIGS. **6-7**, the housing **601** may also be configured to serve as a protective housing for one or more acoustic elements, such as a microphone or speaker. Additionally, in some embodiments, the housing **601** may also be configured to inhibit the ingress of foreign particulate or moisture. In particular, the housing **601** may include a speaker port having orifices **831**, **832** that are configured to transmit acoustic signals but also prevent the ingress of liquid or other foreign particulate. In the present example, the speaker port includes orifices **831**, **832** that are offset with respect to an acoustic chamber or cavity to prevent the direct ingress of liquid into the speaker

subassembly or acoustic module. In the present example, a shielding or umbrella portion of the housing, which is substantially free of openings, is formed between the orifices **831**, **832**, which helps to prevent the direct ingress of liquid. Similarly, the housing **601** includes a microphone port having orifices **833**, **834** that are offset from a corresponding acoustic chamber or cavity to prevent the direct ingress of liquid into the microphone subassembly or acoustic module.

In the example depicted in FIG. **8**, the orifices **831**, **832** of the speaker port are located on one side of the aperture **821** for the crown and the orifices **833**, **834** for the microphone are located on the other side of the aperture **821**. Both the orifices **831**, **832** of the speaker port and the orifices **833**, **834** for the microphone are located on a curved portion of the housing **601**.

3. Example Force Sensor and Touch Sensor

As discussed previously, a wearable electronic device may include one or more sensors for detecting the location and force of a touch. For the purposes of the following description of the force sensor and touch sensor, the described device **100** is one example of that shown and discussed above with respect to FIGS. **2-7**. However, certain features of the device **100** including the external surface geometry, may be simplified or vary with respect to aspects of the device **100** discussed above.

In some embodiments, a force sensor and a touch sensor may be disposed relative to the display of a wearable electronic device for to form a touch-sensitive surface. The following description is provided with respect to individual force and touch sensors that may be used to determine the force and location of a touch, respectively. However, in some embodiments, a single integrated sensor may be used to detect both the force and location of a touch on the device.

In one embodiment, an output from a force sensor may be combined with a touch sensor to provide both location and force of a single touch or of multiple touches on the surface of a device. In an alternative embodiment, a hybrid or integrated force and touch sensor may be used to sense both touch force and location of a single touch or of multiple touches. In either embodiment, by sensing both the force and location of a touch, multiple types of user input may be generated and interpreted. In one example, a first touch may be correlated with a first force and a first touch location or gesture. Based on the magnitude of the force, the first touch may be interpreted as a first type of input or command. A second touch may be sensed as having a second, different force and a similar location or gesture as the first touch. Based in part on the magnitude of the second force, the second touch may be interpreted as a second type of input or command. Thus, a force sensor (alone or in combination with another touch sensor) may be used to produce different responses or outputs depending on the force of the touch.

The one or more force sensors may be formed from or may be implemented as one or more types of sensor configurations. For example, capacitive and/or strain based sensor configurations may be used alone or in combination to detect and measure the magnitude of a touch. As described in more detail below, a capacitive force sensor may be configured to detect the magnitude of a touch based on the displacement of a surface or element on the device. Additionally or alternatively, a strain-based force sensor may be configured to detect the magnitude of a touch based on a deflection of the surface, such as the cover glass.

By way of example, the force sensor may include a capacitive force sensor, which may be formed from one or more capacitive plates or conductive electrodes that are separated by a compressible element or other compliant member. As a force is applied to a surface of the device, the compressible element may deflect resulting in a predictable change in the capacitance between the plates or electrodes. In some implementations, a capacitive force sensor may be formed from transparent materials and disposed over the display. In other implementations, a capacitive force sensor may be formed from non-transparent materials and disposed beneath or around the perimeter of a display.

FIG. **9** depicts a detail cross-sectional view of a portion of a force sensor **900** that may be arranged around the perimeter of a display **120**. As shown in FIG. **9**, a force-sensing structure **901** of the force sensor **900** may be disposed beneath the cover **609** and along the side of an edge or the perimeter of the display **120**. In this example, the force sensor **900** is configured to detect and measure the force of a touch on the surface **911** of the cover **609**. In the present embodiment, a first capacitive plate **902** is fixed with respect to the cover **609**. A second, lower capacitive plate **904** is fixed with respect to the housing **601** and may be disposed on a shelf or mounting surface located along the perimeter of the device. The first capacitive plate **902** and the second capacitive plate **904** are separated by a compressible element **906**.

In the configuration depicted in FIG. **9**, a touch on the surface **911** of the device may cause a force to be transmitted through the cover **609** of the device and to the force sensor **900**. In some cases, the force causes the compressible element **906** to compress, thereby bringing the first capacitive plate **902** and the second capacitive plate **904** closer together. The change in distance between the first and second capacitive plates **902**, **904** may result in a change of capacitance, which may be detected and measured. For example, in some cases, a force-sensing circuit may measure this change in capacitance and output a signal that corresponds to the measurement. A processor, integrated circuit or other electronic element may correlate the circuit output to an estimate of the force of the touch. Although the term "plate" may be used to describe certain elements, such as the capacitive plates or conductive electrodes, it should be appreciated that the elements need not be rigid but may instead be flexible (as in the case of a trace or flex).

FIG. **10**A depicts an example configuration of the force sensor **1000** having four individual force-sensing structures **1001***a-d* arranged around the perimeter of a display in a device. For the sake of clarity, the crystal, display, and other elements of the device are omitted from the depiction of FIG. **10**A. Each of the force-sensing structures **1001***a-d* may be formed from a pair of capacitive plates separated by a compressible element. Additionally, each force-sensing structure **1001***a-d* may be separated by a small gap at or near the corners of the opening in the housing **601**. In the example depicted in FIG. **10**A, the four individual force-sensing structures **1001***a-d* may each be operatively coupled to force-sensing circuitry that is configured to detect a change in the capacitance of each force-sensing structure **1001***a-d*. Using the example arrangement depicted in FIG. **10**A, the approximate location of the touch may be determined by comparing the relative change in capacitance of each force-sensing structure **1001***a-d*. For example, a change in capacitance of structure **1001***b* that is larger as compared to a change in capacitance of structure **1001***d* may indicate that the touch is closer to structure **1001***b*. In some embodiments, the degree of the difference in the change in capacitance may be used to provide a more accurate location estimate.

While the configuration shown in FIG. **10**A depicts the force-sensing structures as individual elements separated by a small gap, in some embodiments, the force-sensing structure may be formed as a single continuous piece. FIG. **10**B depicts a force sensor **1050** formed as a single force-sensing structure **1051** formed as a continuous part along the perimeter of the display. Similar to the example described above, the force-sensing structure **1051** may be operatively coupled to force sensing circuitry that is configured to detect a change in the capacitance of one or more capacitive elements of the force-sensing structure **1051**. While the force-sensing structure **1051** is formed as a continuous structure, there may be multiple sensing elements (e.g., capacitive plates) that are disposed within the structure at different locations, and which may be configured to detect deflection or compression of the structure over a portion of entire area of the force-sensing structure **1051**. In some embodiments, the force-sensing structure **1051** may also function as a seal or gasket to prevent ingress of moisture or other foreign contaminants into the main cavity of the housing. Additionally, the force-sensing structure **1051** may be integrated with one or more sealing or adhesive layers that also function as a barrier for foreign contaminants.

As mentioned previously, the force sensor may additionally or alternatively include a strain-based sensing configuration. The strain-based sensing configuration may include, for example, a charge-based or resistive sensor configuration. FIG. **11** depicts a cross-sectional view of a device having an example force sensor **1100** that uses one or more force-sensitive films to detect and measure the force of a touch on a surface **1111** of the cover **609**. In this example, the force sensitive film **1102** and **1104** are formed from a transparent material and are disposed relative to a viewable portion of the display **120**. As shown in FIG. **11**, the force sensor **1100** includes a first force-sensitive film **1102** and a second force-sensitive film **1104** that are separated by one or more intermediate layers **1106**. The force-sensitive films **1102**, **1104** may be configured to produce different electrical outputs in response to a strain or deflection of the cover **609**. In some cases, the intermediate layer **1106** is compressible to allow the first force-sensitive film **1102** to deflect with respect to the second force-sensitive film **1104**. In other cases, the intermediate layer **1106** may not be compressible and the first force-sensitive film **1102** deflects in a predictable manner with respect to the second force-sensitive film **1104**. While FIG. **11** depicts an example force sensor **1100** having two force-sensitive films, alternative embodiments may include only a single force-sensitive film or, alternatively, include more than two force-sensitive films.

In general, a transparent force-sensitive film may include a compliant material that exhibits an electrical property that is variable in response to deformation or deflection of the film. The transparent force-sensitive film may be formed from a piezoelectric, piezo-resistive, resistive, or other strain-sensitive materials. Transparent resistive films can be formed by coating a substrate with a transparent conductive material. Potential transparent conductive materials include, for example, polyethyleneioxythiophene (PEDOT), indium tin oxide (ITO), carbon nanotubes, graphene, silver nanowire, other metallic nanowires, and the like. Potential substrate materials include, for example, glass or transparent polymers like polyethylene terephthalate (PET) or cycloolefin polymer (COP). Typically, when a piezo-resistive or resistive film is strained, the resistance of the film changes as a function of the strain. The resistance can be measured with an electrical circuit. In this way, a transparent piezoresistive or resistive film can be used in a similar fashion as a strain gauge.

If transparency is not required, then other film materials may be used, including, for example, Constantan and Karma alloys for the conductive film and a polyimide may be used as a substrate. Nontransparent applications include force sensing on track pads or the back of display elements. In general, transparent and non-transparent force-sensitive films may be referred to herein as "force-sensitive films" or simply "films."

In some embodiments, the force-sensitive film is patterned into an array of lines, pixels, or other geometric elements herein referred to as film elements. The regions of the force-sensitive film or the film elements may also be connected to sense circuitry using electrically conductive traces or electrodes. FIG. **12** depicts a cross-sectional view a device having a strain-based force sensor **1200** formed from one or more strain pixel elements **1202** and **1204** separated by intermediate layer **1206**. Each of the pixel elements **1202**, **1204** may be separated by a gap **1210**. In the present example, each pixel element **1202**, **1204** may exhibit a measurable change in an electrical property in response to a force being applied to the device. By way of example, as a force is applied to a surface **1211** on the cover **609**, one or more of the pixel elements **1202**, **1204** is deflected or deformed. Sense circuitry, which is in electrical communication with the one or more pixel elements **1202**, **1204**, may be configured to detect and measure the change in the electrical property of the film due to the deflection. Based on the measured electrical property of the pixel elements **1202**, **1204**, an estimated amount of force can be computed. In some cases, the estimated force may represent the magnitude of a touch on the surface **1211** of the device, and be used as an input to a graphical user interface or other element of the device. Additionally, in some embodiments, the relative strain of the individual pixel elements may be compared to estimate a location of the touch. While FIG. **12** depicts an example force sensor **1200** having two layers of pixel elements, alternative embodiments may include only a single layer of pixel elements or, alternatively, include more than two layers of pixel elements.

The pixel elements **1202**, **1204** may be specifically configured to detect strain along one or more directions. In some cases, each pixel element **1202**, **1204** includes an array of traces generally oriented along one direction. This configuration may be referred to as a piezo-resistive or resistive strain gauge configuration. In general, in this configuration the force-sensitive-film is a material whose resistance changes in response to strain. The change in resistance may be due to a change in the geometry resulting from the applied strain. For example, an increase in length combined with decrease in cross-sectional area may occur in accordance with Poisson's effect. The change in resistance may also be due to a change in the inherent resistivity of the material due to the applied strain. For example, the applied strain may make it easier or harder for electrons to transition through the material. The overall effect is for the total resistance to change with strain due to the applied force.

Further, in a piezo-resistive or resistive strain gauge configuration, each pixel may be formed from a pattern of the force-sensitive-film, aligned to respond to strain along a particular axis. For example, if strain along an x-axis is to be measured, the pixel should have a majority of its trace length aligned with the x-axis. By way of example, FIG. **13**A depicts a pixel element **1302** having traces that are generally oriented along the x-axis and may be configured to produce

a strain response that is substantially isolated to strain in the x-direction. Similarly, FIG. **13**B depicts a pixel element **1304** having traces that are generally oriented along the y-axis and may be configured to produce a strain response that is substantially isolated to strain in the y-direction.

In some embodiments, the force-sensitive film may be formed from a solid sheet of material and is in electrical communication with a pattern of electrodes disposed on one or more surfaces of the force-sensitive film. The electrodes may be used, for example, to electrically connect a region of the solid sheet of material to sense circuitry. This configuration may be referred to as a piezo-strain configuration. In this configuration, the force-sensitive film may generate a charge when strained. The force-sensitive film may also generate different amounts of charge depending on the degree of the strain. In some cases, the overall total charge is a superposition of the charge generated due to strain along various axes.

As mentioned previously, a force sensor may be combined with a touch sensor that is configured to detect and measure the location of a touch on the surface of the device. FIG. **14**A depicts a simplified schematic representation of an example mutual capacitance touch sensor. As shown in FIG. **14**A, a touch sensor **1430** may be formed by an array of nodes **1402** formed at the intersection of an array of drive lines **1404** and sense lines **1406**. In this example, stray capacitance C_{stray} may be present at each node **1402** (although FIG. **14**A depicts only one C_{stray} for one column for purposes of simplifying the figure). In the example of FIG. **14**A, AC stimuli V_{stim} **1414**, V_{stim} **1415** and V_{stim} **1417** can be at different frequencies and phases. Each stimulation signal on a row can cause a charge $Q_{sig}=C_{sig}\times V_{stim}$ to be injected into the columns through the mutual capacitance present at the affected nodes **1402**. A change in the injected charge (Q_{sig_sense}) can be detected when a finger, palm or other object is present at one or more of the affected nodes **1402**. V_{stim} signals **1414**, **1415** and **1417** can include one or more bursts of sine waves. Note that although FIG. **14**A illustrates rows **1404** and columns **1406** as being substantially perpendicular, they need not be aligned, as described above. Each column **1406** may be operatively coupled to a receive channel of a charge-monitoring circuit.

FIG. **14**B depicts a side view of an exemplary node in a steady-state (no touch) condition according to examples of the disclosure. In FIG. **14**B, electric field lines **1408** between a column **1406** and a row **1404** separated by dielectric **1410** is shown at node **1402**.

FIG. **14**C depicts a side view of an exemplary pixel in a dynamic (touch) condition. An object such as finger **1412** can be placed near node **1402**. Finger **1412** can be a low-impedance object at signal frequencies, and can have an AC capacitance C_{finger} from the column trace **1406** to the body. The body can have a self-capacitance to ground C_{body} of about 200 pF, where C_{body} can be much larger than C_{finger}. If finger **1412** blocks some electric field lines **1408** between row and column electrodes (those fringing fields that exit the dielectric **1410** and pass through the air above the row electrode), those electric field lines can be shunted to ground through the capacitance path inherent in the finger and the body, and as a result, the steady state signal capacitance C_{sig} can be reduced by DC_{sig}. In other words, the combined body and finger capacitance can act to reduce C_{sig} by an amount DC_{sig} (which can also be referred to herein as C_{sig} sense), and can act as a shunt or dynamic return path to ground, blocking some of the electric field lines as resulting in a reduced net signal capacitance. The signal capacitance at the pixel becomes C_{sig}-DC_{sig}, where DC_{sig} represents the dynamic (touch) component. Note that C_{sig}-DC_{sig} may always be nonzero due to the inability of a finger, palm or other object to block all electric fields, especially those electric fields that remain entirely within the dielectric material. In addition, it should be understood that as finger **1412** is pushed harder or more completely onto the touch sensor, finger **1412** can tend to flatten, blocking more and more of the electric fields lines **1408**, and thus DC_{sig} may be variable and representative of how completely finger **1412** is pushing down on the panel (i.e., a range from "no-touch" to "full-touch").

Additionally or alternatively, the touch sensor may be formed from an array of self-capacitive pixels or electrodes. FIG. **15**A depicts an example touch sensor circuit corresponding to a self-capacitance touch pixel electrode and sensing circuit. Touch sensor circuit **1509** can have a touch pixel electrode **1502** with an inherent self-capacitance to ground associated with it, and also an additional self-capacitance to ground that can be formed when an object, such as finger **1512**, is in proximity to or touching the touch pixel electrode **1502**. The total self-capacitance to ground of touch pixel electrode **1502** can be illustrated as capacitance **1504**. Touch pixel electrode **1502** can be coupled to sensing circuit **1514**. Sensing circuit **1514** can include an operational amplifier **1508**, feedback resistor **1516**, feedback capacitor **1510** and an input voltage source **1506**, although other configurations can be employed. For example, feedback resistor **1516** can be replaced by a switch capacitor resistor. Touch pixel electrode **1502** can be coupled to the inverting input of operational amplifier **1508**. An AC input voltage source **1506** can be coupled to the non-inverting input of operational amplifier **1508**. Touch sensor circuit **1509** can be configured to sense changes in the total self-capacitance **1504** of touch pixel electrode **1502** induced by finger **1512** either touching or in proximity to the touch sensor panel. Output **1520** can be used by a processor to determine a presence of a proximity or touch event, or the output can be inputted into a discreet logic network to determine the presence of a touch or proximity event.

FIG. **15**B depicts an example self-capacitance touch sensor **1530**. Touch sensor **1530** can include a plurality of touch pixel electrodes **1502** disposed on a surface and coupled to sense channels in a touch controller, can be driven by stimulation signals from the sense channels through drive/sense interface **1525**, and can be sensed by the sense channels through the drive/sense interface **1525** as well. After touch controller has determined an amount of touch detected at each touch pixel electrode **1502**, the pattern of touch pixels in the touch screen panel at which touch occurred can be thought of as an "image" of touch (e.g., a pattern of fingers touching the touch screen). The arrangement of the touch pixel electrodes **1502** in FIG. **15**B is provided as one example; however, the arrangement and/or the geometry of the touch pixel electrodes may vary depending on the embodiment.

As previously mentioned, a force sensor may be implemented alone or in combination with another type of touch sensor to sense both touch force and touch location, which may enable more sophisticated user touch input than using touch location alone. For example, a user may manipulate a computer-generated object on a display using a first type of interaction using a relatively light touch force at a given touch location. The user may also interact with the object using a second type of interaction by using a relatively heavy or sharper touch force at the given location. As one specific example, a user may manipulate or move a computer-generated object, such as a window, using a relatively light

touch force. Additionally or alternatively, the user may also select or invoke a command associated with the window using a relatively heavy or sharper touch force. In some cases, multiple types of interactions may be associated with multiple amounts of touch force.

Additionally, it may be advantageous for the user to be able to provide an analog input using a varying amount of force. A variable, non-binary input may be useful for selecting within a range of input values. The amount of force may, in some cases, be used to accelerate a scrolling operation, a zooming operation, or other graphical user interface operation. It may also be advantageous to use the touch force in a multi-touch sensing environment. In one example, the force of a touch may be used to interpret a complex user input performed using multiple touches, each touch having a different magnitude or degree of force. As a specific but non-limiting example, touch and force may be used in a multi-touch application that allows the user to play a varying tone or simple musical instrument using the surface of the device. In such a housing, the force of each touch may be used to interpret a user's interaction with the buttons or keys of a virtual instrument. Similarly, the force of multiple touches can be used to interpret a user's multiple touches in a game application that may accept multiple non-binary inputs at different locations.

4. Sensor or Biosensor Module

As described above with respect to FIG. **2**, a wearable electronic device may include one or more sensors that can be used to calculate a health metric or other health-related information. For the purposes of the following description of the biosensor module, the described device **100** is one example of that shown and discussed above with respect to FIGS. **2-7**. However, certain features of the device **100** including the external surface geometry, may be simplified or vary with respect to aspects of the device **100** discussed above.

In some embodiments, a wearable electronic device may function as a wearable health assistant that provides health-related information (whether real-time or not) to the user, authorized third parties, and/or an associated monitoring device. The wearable health assistant may be configured to provide health-related information or data such as, but not limited to, heart rate data, blood pressure data, temperature data, blood oxygen saturation level data, diet/nutrition information, medical reminders, health-related tips or information, or other health-related data. The associated monitoring device may be, for example, a tablet computing device, phone, personal digital assistant, computer, and the like.

In accordance with some embodiments, the electronic device can be configured in the form of a wearable electronic device that is configured or configurable to provide a wide range of functionality. As described above with respect to FIG. **2**, the wearable electronic device **100** may include a processing units **102** coupled with or in communication with a memory **104**, one or more communications channels **108**, output devices such as a display **120** and speaker **122**, one or more input components **106**, and other modules or components. An example wearable electronic device **100** may be configured to provide or calculate information regarding time, health information, biostatistics, and/or status to externally connected or communicating devices and/or software executing on such devices. The device **100** may also be configured to send and receive messages, video, operating commands, and other communications.

With reference to FIG. **16**, an example device **100** may include various sensors for measuring and collecting data that may be used to calculate a health metric or other health-related information. As one example, the wearable communication device can include an array of light sources **1611-1613** and a detector **1614** that are configured to function as an optical sensor or sensors. In one example, an optical sensor or sensors may implemented as a pairing of one or more light sources **1611-1613** and the detector **1614**. In one example implementation, the detector **1614** is configured to collect light and convert the collected light into an electrical sensor signal that corresponds to the amount of light incident on a surface of the detector **1614**. In one embodiment, the detector may be a photodetector, such as a photodiode. In other embodiments, the detector **1614** may include a phototube, photosensor, or other light-sensitive device.

In some cases, the one or more optical sensors may operate as a photoplethysmography (PPG) sensor or sensors. In some instances, a PPG sensor is configured to measure light and produce a sensor signal that can be used to estimate changes in the volume of a part of a user's body. In general, as light from the one or more light sources passes through the user's skin and into the underlying tissue, some light is reflected, some is scattered, and some light is absorbed, depending on what the light encounters. The light that is received by the detector **1614** may be used to generate a sensor signal, which may be used to estimate or compute a health metric or other physiological phenomena.

The light sources may operate at the same light wavelength range, or the light sources can operate at different light wavelength ranges. As one example, with two light sources, one light source may transmit light in the visible wavelength range while the other light source can emit light in the infrared wavelength range. In some cases, a modulation pattern or sequence may be used to turn the light sources on and off and sample or sense the reflected light. With reference to FIG. **16**, the first light source **1611** may include, for example, a green LED, which may be adapted for detecting blood perfusion in the body of the wearer. The second light source **1612** may include, for example, an infrared LED, which may be adapted to detect changes in water content or other properties of the body. The third **1613** light source may be a similar type or different types of LED element, depending on the sensing configuration.

The optical (e.g., PPG) sensor or sensors may be used to compute various health metrics, including, without limitation, a heart rate, a respiration rate, blood oxygenation level, a blood volume estimate, blood pressure, or a combination thereof. In some instances, blood may absorb light more than surrounding tissue, so less reflected light will be sensed by the detector of the PPG sensor when more blood is present. The user's blood volume increases and decreases with each heartbeat. Thus, in some cases, a PPG sensor may be configured to detect changes in blood volume based on the reflected light, and one or more physiological parameters of the user may be determined by analyzing the reflected light. Example physiological parameters include, but are not limited to, heart rate, respiration rate, blood hydration, oxygen saturation, blood pressure, perfusion, and others.

While FIG. **16** depicts one example embodiment, the number of light sources and/or detectors may vary in different embodiments. For example, another embodiment may use more than one detector. Another embodiment may also use fewer or more light sources than are depicted in the example of FIG. **16**. In particular, in the example depicted in FIG. **16**, the detector **1614** is shared between multiple light

sources **1611-1613**. In one alternative embodiment, two detectors may be paired with two corresponding light sources to form two optical sensors. The two sensors (light source/detector pairs) may be operated in tandem and used to improve the reliability of the sensing operation. For example, output of the two detectors may be used to detect a pulse wave of fluid (e.g., blood) as it passes beneath the respective detectors. Having two sensor readings taken at different locations along the pulse wave may allow the device to compensate for noise created by, for example, movement of the user, stray light, and other effects.

In some implementation, one or more of the light sources **1611-1613** and the detector **1614** may also be used for optical data transfer with a base or other device. For example, the detector **1614** may be configured to detect light produced by an external mating device, which may be interpreted or translated into a digital signal. Similarly, one or more of the light sources **1611-1613** may be configured to transmit light that may be interpreted or translated into a digital signal by an external device.

Returning to FIG. **16**, the device **100** may also include one or more electrodes to measure electrical properties of the user's body. In this example, a first electrode **1601** and second electrode **1602** are disposed on the rear face of the device **100**. The first **1601** and second **1602** electrodes may be configured to make contact with the skin of the user's wrist when the device is being worn. As shown in FIG. **16**, a third electrode **1603** and fourth electrode **1604** may be disposed along a periphery of the device body **610**. In the configuration of FIG. **16**, the third **1603** and fourth **1604** electrodes are configured to come into contact with the skin of the user's other hand (that is not wearing the device **100**). For example, the third **1603** and fourth **1604** electrodes may be contacted when the user pinches the device **100** between two digits (e.g., a forefinger and thumb).

FIG. **16** depicts one example arrangement of electrodes. However, in other embodiments, one or more of the electrodes may be placed in locations that are different than the configuration of FIG. **16**. For example, one or more electrodes may be placed on a top surface or other surface of the device **100**. Additionally, fewer electrodes or more electrodes may be used to contact the user's skin, depending on the configuration.

Using the electrodes of the device, various electrical measurements may be taken, which may be used to compute a health metric or other health-related information. By way of example, the electrodes may be used to detect electrical activity of the user's body. In some cases, the electrodes may be configured to detect electrical activity produced by the heart of the user to measure heart function or produce an electrocardiograph (ECG). As another example, the electrodes of the device may be used to detect and measure conductance of the body. In some cases, the measured conductance may be used to compute a galvanic skin response (GSR), which may be indicative of the user's emotional state or other physiological condition. By way of further example, the electrodes may also be configured to measure other health characteristics, including, for example, a body fat estimate, body or blood hydration, and blood pressure.

In some embodiments, the optical sensors and electrodes discussed above with respect to FIG. **16** may be operatively coupled to sensing circuitry and the processing units **102** to define a health monitoring system. In this capacity, the processing units **102** may be any suitable type of processing device. In one embodiment, the processing units **102** include a digital signal processor. The processing units **102** may receive signals from the optical sensor(s) and/or electrodes and process the signals to correlate the signal values with a physiological parameter of the user. As one example, the processing units **102** can apply one or more demodulation operations to the signals received from the optical sensor. Additionally, the processing units **102** may control the modulation (i.e., turning on and off) of the light sources according to a given modulation pattern or sequence. The processing units **102** may also be used to calculate one or more biometrics or other heath related information.

In some implementations, the wearable electronic device may also receive sensor data or output from an external device. For example, an external mobile device having a global positioning system (GPS) may relay location information to the wearable device, which may be used to calibrate an activity metric, such as a pedometer or distance calculator. Similarly, sensor output of the wearable electronic device may be transmitted to an external device to compute health-related information. For example, output from an accelerometer in the wearable electronic device may be used determine a body position or gesture, which may be relayed to an external device and used to compute health-related information, such as activity level.

In some embodiments, some or all of the biosensors may be integrated into a module that is separate from and attached to the housing **601** of the device **100**. As described above with respect to FIG. **6**, in some embodiments, the biosensors are disposed relative to or attached to a rear cover **608** that is formed from an optically transparent material and is configured to be positioned with the opening of the housing **601**. In some embodiments, the rear cover **608** is disposed completely within the area of the cover so that the two components completely overlap when viewed from above. In some embodiments, the rear cover **608** has an edge that protrudes outwardly from the back surface of the housing **601**. In some embodiments, an edge of the rear cover **608** extends past a flat portion of the back surface of the housing **601**. The rear cover **608** may also have a convex, curved outer contour. The rear cover **608** may have a convex shape that is located within the center and surrounded by the edges of the rear cover **608**. The convex curved area of the rear cover **608** may include one or more windows or apertures that provide operational access to one or more internal components located within the housing. For example, the rear cover **608** may include an array of windows, each window including an aperture or opening for a respective light source **1611-1613** and/or the detector **1614**. In some embodiments, the windows have a curvature that matches the curvature of the convex curved area of the rear cover **608**. In some embodiments, rear cover **608** includes a chamfered edge and a curved bottom surface, the windows being disposed within the curved surface. In some embodiments, two openings of the rear cover **608** are located along a first axis (e.g., an x-axis) and two openings are located along a second axis (e.g., a y-axis) that is transverse to the first axis.

5. Example Wireless Communications with External Devices

A wearable electronic device may include a functionality for performing wireless communications with an external device. For the purposes of the following description, the described device **100** is one example of that shown and discussed above with respect to FIGS. **2-7**. However, certain features of the device **100**, including the external surface

geometry, may be simplified or vary with respect to aspects of the device **100** discussed above.

In some embodiments, the wireless communications are performed in accordance with a Near Field Communications (NFC) protocol. The communication may include an identification protocol and a secured data connection that can be used to identify the user, authorize activity, perform transactions, or conduct other aspects of electronic commerce.

FIG. **17** depicts an example system **1700** including a device **100** that is located proximate to a station **1710**. The station **1710** may include a variety of devices, including, without limitation, a payment kiosk, a vending machine, a security access point, a terminal device, or other similar device. In some cases, the station **1710** is incorporated into a larger system or device. For example, the station **1710** may be incorporated into a security gate of a building or a payment center for a vending system.

As shown in FIG. **17**, the device **100** is a wearable electronic device that may be placed proximate to the station **1710**. In this example, a second device **1720** is carried by a user, and may also be placed proximate to the station **1710**. In some embodiments, the device **100** and/or the second device **1720** includes a radio-frequency identification (RFID) system that is configured to enable one-way or two-way radio-frequency (RF) communications with the station **1710**. The one- or two-way communication may include an identification of the device **100** and the station **1710** to initiate a secured data connection between the two devices. The secured data connection may be used to authorize a transaction between the user and an entity that is associated with the station **1710**.

In some embodiments, the user may initiate a communication with the station **1710** by placing the device **100** near an active region on the station **1710**. In some implementations, the station **1710** is configured to automatically detect the presence of the device **100** and initiate an identification process or routine. The RFID system of the device may include a unique identifier or signature that may be used to authenticate the identity of the user. As previously mentioned, the identification process or routine may be used to establish a secure data connection between the device **100** and the station **1710**. The secure data connection may be used to authorize a purchase or download of data to or from the device **100**. In some cases, the secure data connection may be used to authorize the transfer of funds from a credit card or financial institution in exchange for a product that is associated with the station **1710**. Other transactions or forms of electronic commerce may also be performed using the wireless communication between the device **100** and the station **1710**.

6. Example Wireless Power System

As discussed above, a wearable electronic device may include an internal battery that is rechargeable using an external power source. For the purposes of the following description, the described device **100** is one example of that shown and discussed above with respect to FIGS. **2-7**. However, certain features of the device **100**, including the external surface geometry, may be simplified or vary with respect to aspects of the device **100** discussed above.

One challenge associated with small devices is that it may be difficult to incorporate an electrical port for coupling the device to an external power source. Because wearable electronic devices have limited space for an external connector, it may be advantageous to electrically couple to a device without a cable or external connector. In at least some embodiments, the wearable electronic device described herein may be configured to operate as a receiver in a wireless power transfer system.

A wireless power transfer system, one example of which is an inductive power transfer system, typically includes a power-transmitting structure to transmit power and a power-receiving structure to receive power. In some examples, a power-receiving electronic device includes or otherwise incorporates an inductive power-receiving element configured to receive wireless power and/or charge one or more internal batteries. Similarly, a charging device may include or otherwise incorporate an indicative power-transmitting element configured to wirelessly transmit power to the power-receiving electronic device. The charging device may be configured as a base or dock on which the power-receiving electronic device rests or to which it physically connects in some embodiments. In other embodiments, the charging device may be proximate the electronic device but not necessarily touching or physically coupled.

In many examples, the battery-powered electronic device may be positioned on an external surface of the power-transmitting device, otherwise referred to as a dock. In these systems, an electromagnetic coil within the dock (e.g., transmit coil) may produce a time-varying electromagnetic flux to induce a current within an electromagnetic coil within the electronic device (e.g., receive coil). In many examples, the transmit coil may transmit power at a selected frequency or band of frequencies. In one example the transmit frequency is substantially fixed, although this is not required. For example, the transmit frequency may be adjusted to improve inductive power transfer efficiency for particular operational conditions. More particularly, a high transmit frequency may be selected if more power is required by the electronic device and a low transmit frequency may be selected if less power is required by the electronic device. In other examples, a transmit coil may produce a static electromagnetic field and may physically move, shift, or otherwise change its position to produce a spatially-varying electromagnetic flux to induce a current within the receive coil.

The electronic device may use the received current to replenish the charge of a rechargeable battery or to provide power to operating components associated with the electronic device. Thus, when the electronic device is positioned on the dock, the dock may wirelessly transmit power at a particular frequency via the transmit coil to the receive coil of the electronic device.

A transmit coil and receive coil may be disposed respectively within housings of the dock and electronic device so as to align along a mutual axis when the electronic device is placed on the dock. If misaligned, the power transfer efficiency between the transmit coil and the receive coil may decrease as misalignment increases. Accordingly, in many examples, the wireless power transfer system may include one or more alignment assistance features to effect alignment of the transmit and receive coils along the mutual axis.

FIG. **18** depicts a front perspective view of an example wireless power transfer system **1800** in an unmated configuration. The illustrated embodiment shows an inductive power transmitter dock **1802** that is configured to couple to and wirelessly transmit power to an inductive power receiver accessory, in this case device **100**. The wireless power transfer system **1800** may include one or more alignment assistance features to effect alignment of the device **100** with the dock **1802** along a mutual axis. For example, the housings of the dock **1802** and the device **100** may assist with alignment. In one implementation, a portion

of the housing of the device **100** may engage and/or interlock with a portion of the housing of the dock **1802** in order to effect the desired alignment. In some embodiments, a bottom portion of the device **100** may be substantially convex and a top surface of the dock **1802** may be substantially concave. In other examples, the interfacing surfaces of the dock **1802** and the device **100** may be substantially flat, or may include one or more additional housing features to assist with effecting mutual alignment.

In some embodiments, one or more actuators in the dock **1802** and/or device **100** can be used to align the transmitter and receiver devices. In yet another example, alignment assistance features, such as protrusions and corresponding indentations in the housings of the transmitter and receiver devices, may be used to align the transmitter and receiver devices. The design or configuration of the interface surfaces, one or more alignment assistance mechanisms, and one or more alignment features can be used individually or in various combinations thereof.

Alignment assistance can also be provided with one or more magnetic field sources. For example, a permanent magnet within the dock **1802** may attract a permanent magnet within the device **100**. In another example, a permanent magnet within the device **100** may be attracted by a magnetic field produced by the dock **1802**. In further examples, multiple alignment assistance features may cooperate to effect alignment of the transmit and receive coils. Power transfer efficiency may also decrease if the power consumption of the electronic device changes (e.g., the electronic device transitions from a trickle charge mode to constant current charge mode) during wireless power transfer.

As discussed previously with respect to FIG. **2**, the device **100** may include a processor coupled with or in communication with a memory, one or more communication interfaces, output devices such as displays and speakers, and one or more input devices such as buttons, dials, microphones, or touch-based interfaces. The communication interface(s) can provide electronic communications between the communications device and any external communication network, device or platform, such as, but not limited to, wireless interfaces, Bluetooth interfaces, Near Field Communication interfaces, infrared interfaces, USB interfaces, Wi-Fi interfaces, TCP/IP interfaces, network communications interfaces, or any conventional communication interfaces. The device **100** may provide information regarding time, health, statuses or externally connected or communicating devices and/or software executing on such devices, messages, video, operating commands, and so forth (and may receive any of the foregoing from an external device), in addition to communications.

In the example depicted in FIG. **18**, the dock **1802** may be connected to an external power source, such as an alternating current power outlet, by power cord **1808**. In other embodiments, the dock **1802** may be battery operated. In still further examples, the dock **1802** may include a power cord **1808** in addition to an internal or external battery. Similarly, although the embodiment is shown with the power cord **1808** coupled to the housing of the dock **1802**, the power cord **1808** may be connected by any suitable means. For example, the power cord **1808** may be removable and may include a connector that is sized to fit within an aperture or receptacle opened within the housing of the dock **1802**.

Although the device **100** is shown in FIG. **18** as larger than the dock **1802**, the depicted scale may not be representative of all embodiments. For example, in some embodiments the dock **1802** may be larger than the device **100**. In still further embodiments the two may be substantially the same size and shape. In other embodiments, the dock **1802** and device **100** may take separate shapes.

FIG. **19** depicts a simplified block diagram of relevant aspects of the device **100** and dock **1802**. It may be appreciated that certain components of both the dock **1802** and device **100** are omitted from the figure for clarity. Likewise, the positions of the elements that are shown are meant to be illustrative rather than necessarily portraying a particular size, shape, scale, position, orientation, or relation to one another, although some embodiments may have elements with one or more of such factors as illustrated.

As described previously with respect to FIG. **2**, the device **100** may include one or more electronic components located within the housing **601**. For clarity, some of the components and modules described or depicted in various embodiments are omitted from the depiction of FIG. **19**. As shown in FIG. **19**, the device **100** may include an internal battery **114** that may be used to provide power to the various internal components of the device **100**. As described previously, the internal battery **114** may be rechargeable by an external power supply. In the present example, the internal battery **114** is operably connected to a receive coil **1869** via power conditioning circuit **1810**.

In the present example, the device **100** includes a receive coil **1869** having one or more windings for inductively coupling with a transmit coil **1832** of the dock **1802**. The receive coil **1869** may receive power wirelessly from the dock **1802** and may pass the received power to a battery **114** within the device **100** via power conditioning circuit **1810**. The power conditioning circuit **1810** may be configured to convert the alternating current received by the receive coil **1869** into direct current power for use by other components of the device. In one example, the processing units **102** may direct the power, via one or more routing circuits, to perform or coordinate one or more functions of the device **100** typically powered by the battery **114**.

As shown in FIG. **19**, the dock **1802** includes a transmit coil **1832** having one or more windings. The transmit coil **1832** may transmit power to the device **100** via electromagnetic induction or magnetic resonance. In many embodiments, the transmit coil **1832** may be shielded with a shield element that may be disposed or formed around portions of the transmit coil **1832**. Similarly, the receive coil **1869** may also include a shield element that may be disposed or formed around a portion of the receive coil **1869**.

As shown in FIG. **19**, the dock **1802** also includes a processor **1834** that may be used to control the operation of or coordinate one or more functions of the dock **1802**. In some embodiments, the dock **1802** may also include one or more sensors **1836** to determine whether the device **100** is present and ready to receive transmitted power from the dock **1802**. For example, the dock **1802** may include an optical sensor, such as an infrared proximity sensor. When the device **100** is placed on the dock **1802**, the infrared proximity sensor may produce a signal that the processor **1834** uses to determine the presence of the device **100**. The processor **1834** may, optionally, use another method or structure to verify the presence of the electronic device via sensor **1836**. Examples of different sensors that may be suitable to detect or verify the presence of device **100** may include a mass sensor, a mechanical interlock, switch, button or the like, a Hall effect sensor, or other electronic sensor. Continuing the example, after the optical sensor reports that the device **100** may be present, the processor **1834** may activate a communication channel to attempt to communicate with the device **100**.

As illustrated in FIG. **19**, a bottom surface of the housing of the device **100** may partially contact a top surface of the dock housing. In some implementations, the interfacing surfaces of the device **100** and the dock **1802** may be formed with complementary geometries. For example, as depicted in FIG. **19**, the bottom surface of the device **100** is convex and the top surface of the dock **1802** is concave, following the same curvature as the bottom surface of the device **100**. In this manner, the complementary geometries may facilitate alignment of the electronic device and dock for efficient wireless power transfer.

In some embodiments, the dock **1802** and device **100** may include other alignment assistance features. For example the device **100** may include an alignment magnet **1838** which is positioned and oriented to attract a corresponding alignment magnet **1840** within the dock **1802**. In some cases, when the device **100** is positioned proximate the dock **1802**, the alignment magnets **1838**, **1840** may be mutually attracted, thereby affecting alignment of the portable electronic device **100** and the dock **1802** along a mutual axis. In other examples, the dock **1802** may include a ferromagnetic material in place of the alignment magnet **1840**. In these examples, the alignment magnet **1838** may be attracted to the ferromagnetic material. In still further cases, the receive coil **1869** or transmit coil **1832** may produce a static magnetic field that either attracts or repels either or both of the alignment magnets **1838**, **1840**.

As shown in FIG. **19**, the alignment magnets **1838**, **1840** may be positioned within a respective coil **1869**, **1832**. When the alignment magnets **1838**, **1840** are drawn together, the coils **1869**, **1832** may be placed into alignment. Additionally, the complementary geometries of the device **100** and the dock **1802** may further facilitate alignment when the alignment magnets **1838**, **1840** are drawn together.

7. Example Acoustic Module

As described above, the device may include one or more devices for transmitting and receiving acoustic energy. For the purposes of the following description of the acoustic module, the described device **100** is one example of that shown and discussed above with respect to FIGS. **2-7**. However, certain features of the device **100**, including the external surface geometry, may be simplified or vary with respect to aspects of the device **100** discussed above. As previously discussed, in some embodiments, the device may include a speaker for transmitting acoustic energy and/or a microphone for receiving acoustic energy. For the purposes of the following description, a speaker device and a microphone are referred to generically as an acoustic module, which may be configured to transmit and/or receive acoustic energy depending on the particular implementation.

FIG. **20** depicts a simplified schematic cross-sectional view of a first embodiment of a device having an acoustic module **2006**. The representation depicted in FIG. **20** is not drawn to scale and may omit some elements for clarity. The acoustic module **2006** may represent either a portion of a speaker and/or microphone device described above with respect to the electronic device **100** of FIG. **2**.

As shown in FIG. **20**, an acoustic port **2020** may be formed in the housing **601** of the electronic device. In the present example, the acoustic port **2020** includes first and second orifices **2031**, **2032** that are formed in the housing **601** and acoustically couple the acoustic cavity **2011** of the acoustic module **2006** to the external environment (external to the electronic device). In the present embodiment, the first and second orifices **2031**, **2032** are offset with respect to the opening of the acoustic cavity **2011**. This configuration may help reduce the direct ingress of liquid **2001** into acoustic cavity **2011** of the acoustic module **2006** Also, as shown in FIG. **20** a shield **2021** or umbrella structure that is formed between the orifices **2031**, **2032** blocks the direct ingress of liquid **2001** into the acoustic cavity **2011**. As shown in FIG. **20**, the acoustic module **2006** also includes a screen element **2015** disposed at one end of the acoustic cavity **2011**, which may also prevent the ingress of liquid or other foreign debris into the acoustic cavity **2011**. The acoustic module **2006** also includes a seal **2016** disposed between the housing **601** and the connector element **2012** of the module, which may also be configured to prevent the ingress of water into the device and/or module.

In the present example depicted in FIG. **20**, the acoustic module **2006** may correspond to the speaker **122** described with respect to some embodiments. As shown in FIG. **20**, the acoustic module **2006** includes various components for producing and transmitting sound, including a diaphragm **2010**, a voice coil **2009**, a center magnet **2008**, and side magnets/coils **2007**. These components may cooperate to form a speaker acoustic element. In one implementation, the diaphragm **2010** is configured to produce sound waves or an acoustic signal in response to a stimulus signal in the center magnet **2008**. For example, a modulated stimulus signal in the center magnet **2008** causes movement of the voice coil **2009**, which is coupled to the diaphragm **2010**. Movement of the diaphragm **2010** creates the sound waves, which propagate through the acoustic cavity **2011** of acoustic module **2006** and eventually out the acoustic port **2020** to a region external to the device. In some cases, the acoustic cavity **2011** functions as an acoustical resonator having a shape and size that is configured to amplify and/or dampen sound waves produced by movement of the diaphragm **2010**.

As shown in FIG. **20**, the acoustic module **2006** also includes a yoke **2014**, support **2013**, connector element **2012**, and a cavity wall **2017**. These elements provide the physical support of the speaker elements. Additionally, the connector element **2012** and the cavity wall **2017** together form at least part of the acoustic cavity **2011**. The specific structural configuration of FIG. **20** is not intended to be limiting. For example, in alternative embodiments, the acoustic cavity may be formed from additional components or may be formed from a single component.

The acoustic module **2006** depicted in FIG. **20** is provided as one example of a type of speaker acoustic module. In other alternative implementations, the acoustic module may include different acoustic elements for producing and transmitting sound, including, for example, a vibrating membrane, piezoelectric transducer, vibrating ribbon, or the like. Additionally, in other alternative implementations, the acoustic module may be a microphone acoustic module having one or more elements for converting acoustic energy into an electrical impulse. For example, the acoustic module may alternatively include a piezoelectric microphone acoustic element for producing a charge in response to acoustic energy or sound.

As previously mentioned, because the acoustic port **2020** connects the acoustic module **2006** to the external environment, there is a possibility that liquid may accumulate or infiltrate the interior of the module. In some cases, the screen element **2015** or other protective features may not prevent all liquid from entering the acoustic cavity **2011** of the module. For example, if the device is subjected to a liquid under pressure or a directed stream of liquid, some liquid ingress may occur. Additionally, naturally occurring mois-

ture in the air may condense and accumulate over time resulting in the presence of liquid within the module. Thus, in some implementations, the acoustic module **2006** may include one or more elements configured to expel water or liquid that accumulates in, for example, the acoustic cavity **2011** of the module. The liquid expulsion process may include modifying the charge on a portion of the wall of the acoustic cavity **2011** to change the surface energy of the wall and/or producing an acoustic pulse using the diaphragm **2010** to help expel liquid from the acoustic cavity **2011**. In some embodiments, the screen **2015** may also have hydrophilic or hydrophobic properties that may facilitate removal of liquid held within the acoustic cavity **2011**.

8. Example Antenna and Cover

As previously described, a wearable electronic device may be configured to communicate wirelessly with various external devices and communication networks. For the purposes of the following description, the described device **100** is one example of that shown and discussed above with respect to FIGS. **2**-**7**. However, certain features of the device **100**, including the external surface geometry, may be simplified or vary with respect to aspects of the device **100** discussed above.

In some embodiments, as previously discussed with respect to FIG. **2**, the device may include one or more communication channels that are configured to transmit and receive data and/or signals over a wireless communications network or interface. Example wireless interfaces include radio frequency cellular interfaces, Bluetooth interfaces, Wi-Fi interfaces, or any other known communication interface.

In some implementations an antenna may be disposed with respect to the cover (e.g., crystal) of a device to facilitate wireless communications with an external device or communication network. In some cases, it may be advantageous to integrate an antenna into the cover to improve the transmission and reception of wireless signals from the device. In particular, the cover of the device may have dielectric properties that facilitate the transmission of radio frequency signals while also protecting the antenna from physical damage or interference. Additionally, if the antenna is integrated into a perimeter portion of the cover, the visual appearance or clarity of the cover may be minimized. Furthermore, the embodiments described below with respect to FIGS. **21**A-B may be used to integrate an antenna external to the housing, without increasing the thickness of the device body.

FIG. **21**A depicts a perspective exploded view of a cover **2100** and an antenna assembly **2130**. The cover **2100** depicted in FIG. **21**A is viewed from an inner surface **2124** that is configured to attach to or interface with the opening of the housing (described above with respect to FIG. **1**). As shown in FIG. **21**A, a groove **2128** may be formed within the inner surface **2124**. In this example, the groove **2128** is formed around the periphery of the cover **2100**. As mentioned previously, this may be advantageous in minimizing the visual impact of having the antenna assembly **2130** located within the cover **2100**.

As shown in FIG. **21**A the antenna assembly **2130** includes an antenna ring **2134** and a terminal **2140** which may interface with an electrical connector **2150**. In the present embodiment, the groove **2128** formed in the surface of the cover **2100** may be configured to accept the antenna ring **2134**. In particular, the groove **2128** may receive the entire antenna ring **2134** without a portion of the antenna ring **2134** protruding past the inner surface **2124**, when the antenna ring **2134** is installed. In some cases, the groove **2128** is formed to be a clearance or near clearance fit with the diameter of the antenna ring **2134**. Thus, in some cases, the antenna ring **2134** may substantially fill the groove **2128** when the ring is installed. In some cases, the groove **2128** may be configured to retain the antenna ring **2134** due to a slight interference fit or due to a feature formed within either the cover **2100** and/or the antenna assembly **2130**. In the present embodiment, the antenna assembly **2130** may be installed in the cover **2100** and then connected to other electronics via the terminal **2140** and the connector **2150**, which may protrude into an opening in the case or housing.

FIG. **21**B depicts a cross-sectional view of the cover and antenna at the connection point. In particular, FIG. **21**B depicts a detail cross-sectional view of the cover **2100** installed within the housing **601** at a region near the terminal **2140**. In this example, the cover **2100** is attached to a shelf of the housing **601** via a compressible element **2122**. The compressible element **2122** may provide a seal against water or other contaminates and also provide compliance between the cover **2100** and the housing **601**. The compressible element **2122** may be formed from a nitrile or silicone rubber and may also include an adhesive or other bonding agent.

As shown in FIG. **21**B, the antenna ring **2134** is disposed entirely within the groove **2128**. In this case, the antenna ring **2134** does not protrude past the inner surface **2124**. The antenna ring **2134** is electrically connected to the terminal **2140**, which protrudes into an opening in the housing **601**. As shown in FIG. **21**B, the terminal **2140** includes conductive pads **2142** for electrically connecting to the antenna ring **2134**. In this example, spring clips **2152** are configured to mechanically and electrically connect to the conductive pads **2142** on the terminal **2140**. One advantage to the configuration depicted in FIG. **21**B is that the antenna assembly **2130** may be installed in the cover **2100** before the cover **2100** is installed in the housing **601**. The terminal **2140** and connector **2150** facilitate a blind connection that may assist electrical connection as the cover **2100** is installed. Additionally, the configuration depicted in FIG. **21**B may allow for some movement between the cover **2100** and the housing **601** without disturbing the electrical connection with the antenna ring **2134**.

9. Example Haptic Module

As described above, the device may include one or more haptic modules for providing haptic feedback to the user. The embodiments described herein may relate to or take the form of durable and thin haptic feedback elements suitable to provide a perceivable single pulse haptic feedback. In general, a haptic device may be configured to produce a mechanical movement or vibration that may be transmitted through the housing and/or other component of the device. In some cases, the movement or vibration may be transmitted to the skin of the user and perceived as a stimulus or haptic feedback by the user. In some implementations, the haptic feedback may be coupled to one or more device outputs to alert the user of an event or activity. For example, a haptic output may be produced in combination with an audio output produced by the speaker, and/or a visual output produced using the display.

The space constraints associated with a small wrist-worn device may present unique challenges to integrating a haptic mechanism into wearable electronics. In particular, a haptic mechanism may use a moving mass used to create the

movement or vibration of the haptic output. The larger the mass that is moved, the easier it may be to create a perceivable stimulus using the haptic mechanism. However, a large moving mass and the supporting mechanism may be difficult to integrate into the compact space of, for example, the housing of a wearable electronic wristwatch.

Thus, the haptic module implemented in some embodiments may be configured to maximize the mechanical energy that is produced in a very compact form factor. FIGS. **22**A-B depict one example haptic mechanism that may be particularly well suited for use in a wearable electronic device. While the embodiment described with respect to FIGS. **22**A-B is provided as one example, the haptic module is not limited to this particular configuration.

FIG. **22**A depicts a three-quarters perspective view of a haptic device **112**, with a top, front and left sidewall of the housing **2220** removed to expose internal components. FIG. **22**B depicts a cross-sectional perspective view of the haptic device **112** cut in half to expose the internal components. In this example, a coil **2200** is used to induce movement of a frame **2260**, which houses a central magnet array **2210**. As shown in FIGS. **22**A-B, the movement of the frame **2260** is guided by a shaft **2250** that is fixed with respect to a housing **2220**.

In the present example, the coil **2200** may be energized by transmitting a current (e.g., from the battery) along a length of a wire that forms the coil **2200**. A direction of the current along the wire of the coil **2200** determines a direction of a magnetic field that emanates from the coil **2200**. In turn, the direction of the magnetic field determines a direction of movement of the frame **2260** housing the central magnet array **2210**. One or more springs may bias the frame **2260** towards the middle region of the travel. In this example, the frame **2260** and central magnet array **2210**, through operation of the coil **2200**, function as a moving mass, which generates a tap or vibration. The output of the haptic device **112**, created by the moving mass of the frame **2260** and central magnet array **2210**, may be perceived as a haptic feedback or stimulus to the user wearing the device.

For example, when the coil **2200** is energized, the coil **2200** may generate a magnetic field. The opposing polarities of the magnets in the magnet array **2210** generates a radial magnetic field that interacts with the magnetic field of the coil **2200**. The Lorentz force resulting from the interaction of the magnetic fields causes the frame **2260** to move along the shaft **2250** in a first direction. Reversing current flow through the coil **2200** reverses the Lorentz force. As a result, the magnetic field or force on the central magnet array **2210** is also reversed and the frame **2260** may move in a second direction. Thus, frame **2260** may move in both directions along the shaft **2250**, depending on the direction of current flow through the coil **2200**.

As shown in FIG. **22**A, the coil **2200** encircles the central magnet array **2210**, which is disposed near the center of the frame **2260**. As previously described, the coil **2200** may be energized by transmitting a current along the length of the wire forming the coil **2200**, and the direction of the current flow determines the direction of the magnetic flux emanating from the coil **2200** in response to the current. Passing an alternating current through the coil **2200** may cause the central magnet array **2210** (and frame **2260**) to move back and forth along a shaft **2250**. In order to prevent the central magnet array **2210** from being attracted to the shaft **2250**, which could increase friction between the two and thereby increase the force necessary to move the central magnet array **2210** and frame **2260**, the shaft **2250** may be formed from a non-ferrous material such as tungsten, titanium, stainless steel, or the like.

As depicted in FIGS. **22**A-B, the coil **2200** is positioned within a frame **2260** that holds the central magnet array **2210**, but is not affixed to the coil **2200**. Rather, an air gap separates the coil **2200** from the central magnet array **2210** and the frame **2260** is free to move with respect to the coil **2200**, which is generally stationary. Further, the frame **2260** generally moves with the central magnet array **2210**. As illustrated in FIGS. **22**A-B, the frame **2260** may have an aperture formed therein of sufficient size to contain the coil **2200**. Even when the frame and central magnet array are maximally displaced within the housing **2220** (e.g., to one end or the other of the shaft **2250**), the coil **2200** does not contact any portion of the frame **2260**. It should be appreciated that the coil **2200** remains stationary in the housing **2220** while the frame **2260** and central magnet array **2210** move, although in other embodiments the coil **2200** may move instead of, or in addition to, the frame and/or central magnet array. However, by keeping the coil **2200** stationary, it may be easier to provide interconnections for the coil, such as between the coil and the flex, and therefore reduce the complexity of manufacture.

As shown in FIGS. **22**A-B, the central magnet array **2210** may be formed from at least two magnets **2211**, **2212** of opposing polarities. A center interface **2270** may be formed from a ferrous or non-ferrous material, depending on the embodiment. A ferrous material for the center interface **2270** may enhance the overall magnetic field generated by the central magnet array **2210**, while a non-ferrous material may provide at least a portion of a return path for magnetic flux and thus assist in localizing the flux within the housing **2220**. In some embodiments, the magnets **2211**, **2212** are formed from neodymium while the frame is tungsten. This combination may provide a strong magnetic field and a dense mass, thereby yielding a high weight per volume structure that may be used as the moving part of the haptic device **112**.

10. Example Crown Module

As described above, the device may include a crown that may be used to accept user input to the device. For the purposes of the following description, the described device **100** is one example of that shown and discussed above with respect to FIGS. **2-7**. However, certain features of the device **100**, including the external surface geometry, may be simplified or vary with respect to aspects of the device **100** discussed above.

In some embodiments, a crown may be used to accept rotary input from the user, which may be used to control aspects of the device. The crown may be knurled or otherwise textured to improve grip with the user's finger and/or thumb. In some embodiments, a crown may be turned by the user to scroll a display or select from a range of values. In other embodiments, the crown may be rotated to move a cursor or other type of selection mechanism from a first displayed location to a second displayed location in order to select an icon or move the selection mechanism between various icons that are output on the display. In a time keeping application, the crown may also be used to adjust the position of watch hands or index digits displayed on the display of the device. The crown may also be used to control the volume of a speaker, the brightness of the display screen, or control other hardware settings.

In some embodiments, the crown may also be configured to accept linear, as well as rotary, input. For example, the

crown may be configured to translate along an axis when pressed or pulled by the user. In some cases, the linear actuation may be used as additional user input. The actuation may provide a binary output (actuated/not actuated) or may also provide a non-binary output that corresponds to the amount of translation along the axis of motion. In some instances, the linear input to the crown may be combined with the rotary input to control an aspect of the device.

The embodiments described herein may be used for at least a portion of the crown module integrated into a wearable electronic device. The embodiments are provided as examples and may not include all of the components or elements used in a particular implementation. Additionally, the crown module is not intended to be limited to the specific examples described below and may vary in some aspects depending on the implementation.

In some embodiments, an optical encoder may be used to detect the rotational motion of the crown. More specifically, the example provided below with respect to FIG. **23** may use an optical encoder to detect rotational movement, rotational direction and/or rotational speed of a component of the electronic device. Once the rotational movement, rotational direction and/or rotational speed have been determined, this information may be used to output or change information and images that are presented on a display or user interface of the electronic device.

Integrating an optical encoder into the space constraints of a typical wearable electronic device may be particularly challenging. Specifically, some traditional encoder configurations may be too large or delicate for use in a portable electronic device. The optical encoder described below may provide certain advantages over some traditional encoder configurations and may be particularly well suited for use with a crown module of a wearable electronic device.

As shown in the example embodiment of FIG. **23**, the optical encoder of the present disclosure includes a light source **2370**, a photodiode array **2380**, and a shaft **2360**. However, unlike typical optical encoders, the optical encoder of the present disclosure utilizes an encoding pattern disposed directly on the shaft **2360**. For example, the encoding pattern includes a number of light and dark markings or stripes that are axially disposed along the shaft **2360**. Each stripe or combination of stripes on the shaft **2360** may be used to identify a position of the shaft **2360**. For example, as light is emitted from the light source **2370** and reflected off of the shaft **2360** into the photodiode array **2380**, a position, rotation, rotation direction and rotation speed of the shaft **2360** may be determined. Once the rotation direction and speed are determined, this information may be used to output or change information or images that are presented on the display or user interface of the electronic device.

In other embodiments, the shape or form of the shaft of the encoder may be used to determine a position, rotation, rotation direction and rotation speed of the shaft. For example, the shaft may be fluted or have a number of channels that cause the light to be reflected in a number of different directions. Accordingly, a diffractive pattern may be used to determine the rotation, rotation direction and rotation speed of the shaft.

FIG. **23** illustrates a simplified depiction of the device **100** and crown module **642** in accordance with some embodiments. As shown in FIG. **23**, the crown module **642** may be integrated with the housing **601** of the device **100** and may be formed from a dial **2340** disposed at the end of a shaft **2360**. In the present embodiment, the crown module **642** also forms part of the optical encoder. As discussed above, the crown module **642** includes an optical encoder that includes a shaft **2360**, a light source **2370**, and a photodiode array **2380**. Although a photodiode array is specifically mentioned, embodiments disclosed herein may use various types of sensors that are arranged in various configurations for detecting the movement described herein. For example, the movement of the shaft **2360** may be detected by an image sensor, a light sensor such as a CMOS light sensor or imager, a photovoltaic cell or system, photo resistive component, a laser scanner and the like.

The optical encoder may produce an encoder output that is used to determine positional data of the crown module **642**. In particular, the optical encoder may produce an output that is used to detect that movement of the dial **2340** including the direction of the movement, speed of the movement and so on. The movement may be rotational movement, translational movement, angular movement, and so on. The optical encoder may also be used to detect the degree of the change of rotation of the dial **2340** and/or the angle of rotation of the dial **2340** as well as the speed and the direction of the rotation of the dial **2340**.

The signals or output of the optical encoder may be used to control various aspects of other components or modules of the device. For example, continuing with the time keeping application example discussed above, the dial **2340** may be rotated in a clockwise manner in order to advance the displayed time forward. In one implementation, the optical encoder may be used to detect the rotational movement of the dial **2340**, the direction of the movement, and the speed at which the dial **2340** is being rotated. Using the output from the optical encoder, the displayed hands of a time keeping application may rotate or otherwise move in accordance with the user-provided rotational input.

Referring back to FIG. **23**, the crown module **642** may be formed from dial **2340** that is coupled to the shaft **2360**. In some cases, the shaft **2360** and dial **2340** may be formed as a single piece. As the shaft **2360** is coupled to, or is otherwise a part of the dial **2340**, as the dial **2340** rotates or moves in a particular direction and at a particular speed, the shaft **2360** also rotates or moves in the same direction and with the same speed.

As shown in FIG. **23**, the shaft **2360** of the optical encoder includes an encoding pattern **2365**. As discussed above, the encoding pattern **2365** may be used to determine positional information about the shaft **2360** including rotational movement, angular displacement and movement speed. As shown in FIG. **23**, the encoding pattern **2365** may include a plurality of light and dark stripes.

Although light stripes and dark stripes are specifically mentioned and shown, the encoding pattern **2365** may consist of various types of stripes having various shades or colors that provide surface contrasts. For example, the encoding pattern **2365** may include a stripe or marking that has a high reflective surface and another stripe that has a low reflective surface regardless of the color or shading of the stripes or markings. In another embodiment, a first stripe of the encoding pattern **2365** may cause specular reflection while a second stripe of the encoding pattern **2365** may cause diffuse reflection. When the reflected light is received by the photodiode array **2380**, a determination may be made as to the position and movement of the shaft such as described below. In embodiments where a holographic or diffractive pattern is used, the light from the light source **2370** may diffract from the shaft **2360**. Based on the diffracted light, the photodiode array **2380** may determine the position, movement and direction of movement of the shaft **2360**.

In some embodiments, the stripes of the encoding pattern **2365** extend axially along the shaft **2360**. The stripes may extend along the entire length of the shaft **2360** or partially along a length of the shaft **2360**. In addition, the encoding pattern **2365** may also be disposed around the entire circumference of the shaft **2360**. In other embodiments, the encoding pattern **2365** may include a radial component. In yet other embodiments, the encoding pattern **2365** may have both a radial component and an axial component.

In some embodiments, the crown module may also include a tactile switch for accepting translational input from the user. FIGS. **24**A-B depict another example of a crown module **642***a* having a tactile switch assembly **2410**. As shown in FIG. **24**A, the tactile switch assembly **2410** may include a dial **2448** (or button), a coupling **2418**, a shear plate **2456**, and a tactile switch **2414**.

In the embodiment depicted in FIGS. **24**A-B, the dial **2448** is translatable and/or rotatable relative to the housing. The ability of the dial **2448** to translate and rotate relative to the housing allows a user to provide a rotational force and/or translating force to the tactile switch assembly. In particular, the dial **2448** of the present example may be operably coupled to or form part of an optical encoder, in accordance with the example described above with respect to FIG. **23**.

In the present example, the dial **2448** includes an outer surface **2432** that is configured to receive a rotary or rotational user input and a stem **2450** that extends from an interior surface **2434** of the dial **2448**. The stem **2450** may define a coupling aperture that extends longitudinally along a length or a portion of a length of the stem **2450**. In the depicted example, the stem **2450** may be hollow or partially hollow.

In the example depicted in FIGS. **24**A-B, the coupling **2418** may be a linkage, such as a shaft, that couples the dial **2448** to the tactile switch **2414**. The coupling **2418** may be integrally formed with the dial **2448** or may be a separate component operably connected thereto. For example, the stem **2450** of the dial **2448** may form the coupling member that is integrally formed with the dial **2448**. The coupling **2418** may be made of a conductive material, such as one or more metals or metal alloys. Due to the conductive characteristics, the coupling **2418** may further act to electrically couple the dial **2448** to the tactile switch **2414** and shear plate **2456**. In the example depicted in FIGS. **24**A-B, the shear plate **2456** is positioned between the coupling **2418** and the tactile switch **2414**. In some embodiments, the shear plate **2456** may prevent or reduce shearing forces from the coupling from being transmitted to the tactile switch. The shear plate **2456** also allows transfer of linear force input from the dial **2448** to the switch **2414**.

The configuration depicted in FIGS. **24**A-B may be used to accept both rotational and translational input from the user. For example, if a user provides a rotational force to the dial **2448**, the coupling **2418** and dial **2448** may rotate in the direction of the force. The coupling **2418** may be attached to or integrated with one or more sensors that are configured to detect rotational movement. For example the coupling **2418** may be integrated with an optical encoder, similar to the example described above with respect to FIG. **23**. Additionally, if a user provides a translational force to the dial **2448**, the force may be transmitted through the dial **2448** and coupling **2418** to actuate the switch **2414**. In some cases, the switch **2414** includes a metal dome switch that is configured to provide a tactile feedback when actuated. In some cases, the actuation of a dome switch may be perceived by the user as a click or release as the switch **2414** is actuated. Once the force has been removed from the dial **2448**, the dome switch

resiliently returns to its original position, providing a biasing force against the coupling **2418** to return both the dial **2448** and the coupling **2418** to their original positions. In some embodiments, the tactile switch **2414** may include a separate biasing element, such as a spring, that exerts a force (either directly or indirectly via the shear plate) against the coupling. FIG. **24**A depicts the tactile switch assembly **2410** when there is no force applied (un-actuated). FIG. **24**B depicts the tactile switch assembly **2410** when there is a translational force applied to the dial **2448** (actuated).

11. Example Band Attachment Mechanism

For the purposes of the following description, the described device **100** is one example of that shown and discussed above with respect to FIGS. **2-7**. However, certain features of the device **100**, including the external surface geometry, may be simplified or vary with respect to aspects of the device **100** discussed above.

As described above, a wearable electronic device may include a band that is attached to a device body having one or more receiving features. In particular, the housing may include or form a receiving feature that facilitates an interchange or replacement of different bands that are used to secure the device to the wrist of the user. By replacing or interchanging bands the device may be adapted for multiple uses ranging from sporting activities to professional or social activities.

In some embodiments, the receiving features are configured to be operated without the use of special tools or fixtures. For example, the bands may be interchanged by hand or with the help of a simple tool, such as a pointed object. Additionally or alternatively, a tool or other component, such as a component of the device to which the attachment system is coupled, may be configured to actuate a button or other component of the attachment system to secure and/or release the band from the device. In one embodiment, the lug portion of a band may be configured to be inserted into an opening or channel portion of the receiving feature. Once the lug of the band has been inserted into the opening, the lug may slide within the opening of the device until the band is secured or otherwise coupled to the device. The coupling between the band and the receiving feature may provide a secure attachment of the band to the housing or device body. Just as the band is configured to slide into the channel of the receiving feature, the lug may also slide out of the channel of the receiving feature allowing the band to be detached from the device body.

In one embodiment, the receiving feature includes a locking mechanism, which may be integrated with portions of either the band or the receiving feature. In one example, as the band is inserted into a receiving feature of the device, the locking mechanism interfaces with a portion of the receiving feature to lock or otherwise secure the band within the receiving feature. The locking mechanism may also be configured to interface with a releasing mechanism associated with the receiving feature. For example, a releasing mechanism may be configured to disengage or release the locking mechanism. In some implementations, actuation of the releasing mechanism causes the locking mechanism to be released and allows the band to be removed by sliding within the receiving feature.

FIG. **25**A depicts a receiving feature and band assembly as viewed from the bottom of the device body. As shown in FIG. **25**A, a receiving feature **623***a* includes an opening or channel **2501** that is formed into the body or housing of the device. The channel **2501** is configured to receive the lug

2510 attached to an end of the band strap **621***a*. The receiving feature **623***a* may also include a locking mechanism **2530** that is configured to maintain the band strap **621***a* within the channel **2501** once it has been installed. As discussed above, the locking mechanism **2530** may be releasable by the user, which may facilitate band replacement. In this example, the locking mechanism **2530** includes a spring-loaded retaining mechanism that engages the lug **2510** to retain the lug **2510** in the channel **2501** and maintain the attachment of the band strap **621***a* to the device. As shown in FIG. **25**A, the locking mechanism **2530** also includes a button located on the bottom of the housing that may be depressed by the user to release the locking mechanism and allow the lug **2510** and the band strap **621***a* to be removed from the channel **2501**. In the present example, the button of the locking mechanism **2530** is located on a curved portion of the case or housing. In some embodiments, the button of the locking mechanism **2530** is located along the centerline of the case or housing.

In some embodiments, the opening or channel **2501** of the receiving feature **623***a* includes a port or connector for receiving a mating electrical component. In some embodiments, the connector or port is covered by a label or sticker so that the inside surface of the opening or channel **2501** appears continuous. The connector or port may be located along the vertical centerline of the case or housing.

FIG. **25**B depicts an example exploded view of the receiving feature **623***a* and the lug **2510** of the band strap **621***a*. As shown in FIG. **25**B, the band strap **621***a* may be formed from a separate part and attached to lug **2510** via a pivot or other type of joint. In other embodiments, the band strap **621***a* may have an end feature that is integrally formed as part of the band strap **621***a*. As also shown in FIG. **25**B, the lug **2510** may be attached to the receiving feature **623***a* by aligning the axis of the lug **2510** with the axis of the channel **2501** and then sliding the lug **2510** into the channel **2501**.

FIG. **25**C depicts an example assembly sequence of the lug **2510** being inserted into the channel **2501** of the receiving feature **623***a*. As shown in FIG. **25**C, the lug **2510** may be positioned along the side of the receiving feature **623***a* having the lug **2510** approximately aligned with the channel **2501** of the receiving feature **623***a*. The lug **2510** (and band strap **621***a*) may then be inserted into the channel **2501** of the receiving feature **623***a* by sliding the lug **2510** along the length of the channel **2501**. Once the lug **2510** is approximately centered in the channel **2501** of the receiving feature **623***a*, the locking mechanism **2530** or other securing feature may engage, thereby retaining the lug **2510** (and band strap **621***a*) within the channel **2501**. As previously discussed, the lug **2510** (and band strap **621***a*) may be removed from the receiving feature **623***a* by depressing the button of the locking mechanism **2530**, which may disengage the lock and allow movement of the lug **2510** within the channel **2501**.

The example described above is provided with respect to one example embodiment. The geometry of the end of the band strap and/or the geometry of the channel may vary depending on the implementation. Additionally, the engagement mechanism may vary depending on the design of the band strap and the device body. The geometry or layout of the features may vary and remain within the scope of the present disclosure. Additionally, while the examples provided above are described with respect to attaching a band strap to a device body, the receiving feature (**623***a*) may be used to attach a variety of other parts to the device body. For example a lanyard, cable, or other accessory may be attached to the device body using the receiving feature and other similar features.

12. Example Bands

As described above, a wearable electronic device may include a band that is used to secure the device to the wrist of a user. In some embodiments, the band may be formed from two band straps that are attached to the housing of the device body. The band straps may be secured around the wrist of a user by a clasp or latching mechanism. As also described above, the device may be configured to facilitate replacement of the band. This feature may allow the use of a variety of types of bands, which may adapt the device for multiple uses ranging from sporting activities to professional or social activities.

In some cases, the band may be formed from a woven textile material. In one example, the band is formed from a woven material that includes one or more strands or threads formed from a natural or synthetic material. The woven material may be formed, for example, from a plurality of warp threads that are woven around one or more weft threads. More specifically, the woven material may include a plurality of warp threads disposed along the length of the band, and at least one weft thread positioned perpendicular to, and coupled to, woven or interlaced between the plurality of warp threads. In some cases, the plurality of warp threads may run the entire length of the woven portion of the band strap. Additionally, in some cases, the at least one weft thread may include a single thread that may be continuously woven between the plurality of warp threads or, alternatively, may include a plurality of threads that may be woven between the plurality of warp threads. A weft thread that is woven between a plurality of warp threads may form consecutive cross-layers with respect to the plurality warp threads in order to form the band.

In some cases, one or more of the strands or threads may be a metallic or conductive material. This may improve the strength of the band and may also facilitate coupling with magnetic elements, such as a metallic clasp. In some cases, other elements may be woven into the band, including, for example, product identifying elements, decorative elements, or functional components.

In other embodiments, the band may be formed from a metallic mesh material. In one example, the metallic mesh is formed from an array of links that are interlocked to form a sheet of fabric. Some or all of the links in the mesh may be formed from a ferromagnetic material, which may facilitate magnetic engagement with a magnetic clasp. In some cases, each link of the mesh is formed from a section of metallic filament that is bent or formed into a closed shape. Each closed shape may be interlocked with one or more adjacent links to form a portion of the sheet or fabric. In some cases, a metallic filament is formed around a series of rods or pins that are disposed at a regular spacing within the mesh. In some cases, one or more strands or filaments that may be formed from a ferromagnetic material are woven or integrated with the links of the mesh.

In other examples, the band may be formed from a sheet of material. For example, the band may be formed from a synthetic leather, leather, or other animal hide. Additionally or alternatively, the band may be formed from a polymer material, an elastomer material, or other type of plastic or synthetic. In some cases, the band is formed from a silicone sheet material.

The clasp that is used to attach the free ends of the band straps may vary depending on the material that is used and the construction of the band. For example, as mentioned above, a metallic mesh material may use a metallic clasp to join the ends of the band. Additionally, a leather band may be integrated with magnetic and/or ferromagnetic components and may include a magnetic clasp. In some embodiments, the free ends of the band straps are secured using a buckle or tang on a first band strap that is configured to interface with a hole or aperture in a second band strap. A variety of other clasp configurations may also be used.

13. Example Display

For the purposes of the following description, the described device **100** is one example of that shown and discussed above with respect to FIGS. **2**-**7**. However, certain features of the device **100**, including the external surface geometry, may be simplified or vary with respect to aspects of the device **100** discussed above. As described above, the device includes a display disposed within the housing or enclosure. The device may be formed from a liquid crystal display (LCD), organic light emitting diode (OLED) display, organic electroluminescence (OEL) display, or other type of display device. The display may be used to present visual information to the user, including, for example, a graphical user interface, notifications, health statistics, and the like. In some cases, the display may be configured to present the current time and date similar to a traditional watch or timepiece.

In some embodiments, the display is formed from an organic light emitting diode (OLED) display element. An active region of the display may include an array of light-emitting display pixels **2604** such as array **2602**, shown in FIG. **26**. Pixels **2604** may be arranged in rows and columns in array **2602** and may be controlled using a pattern of control lines. Each pixel may include a light-emitting element such as organic light-emitting diode **2612** and associated control circuitry **2610**. Control circuitry **2610** may be coupled to the data lines **2606** and gate lines **2608** so that control signals may be received from driver circuitry, which may be implemented as an integrated circuit. Although described as an OLED display, certain embodiments may implement other display technology, such as LCD displays and the like.

To the extent that multiple functionalities, operations, and structures are disclosed as being part of, incorporated into, or performed by device **100**, it should be understood that various embodiments may omit any or all such described functionalities, operations, and structures. Thus, different embodiments of the device **100** may have some, none, or all of the various capabilities, apparatuses, physical features, modes, and operating parameters discussed herein

Although the disclosure above is described in terms of various exemplary embodiments and implementations, it should be understood that the various features, aspects and functionality described in one or more of the individual embodiments are not limited in their applicability to the particular embodiment with which they are described, but instead can be applied, alone or in various combinations, to one or more of the other embodiments of the invention, whether or not such embodiments are described and whether or not such features are presented as being a part of a described embodiment. Thus, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments but instead defined by the claims herein presented.

We claim:

1. A wearable electronic device comprising:

a housing defining a first opening and a second opening;

a display positioned at least partially within the first opening;

a front cover positioned over the display and defining at least a portion of a front exterior surface of the wearable electronic device;

a biosensor module comprising:

a rear cover positioned at least partially within the second opening and defining an optically transparent window and a protruding convex surface;

an optical sensor aligned with the optically transparent window;

a first electrode positioned along a rear surface of the wearable electronic device; and

a second electrode positioned along the rear surface of the wearable electronic device; and

a third electrode positioned along a side of the wearable electronic device, wherein:

the wearable electronic device is configured to measure a first physiological parameter of a wearer using the optical sensor; and

the wearable electronic device is configured to measure a second physiological parameter using the first electrode, the second electrode, and the third electrode.

2. The wearable electronic device of claim **1**, wherein:

the wearable electronic device further includes a watch band coupled to the housing and configured to couple the wearable electronic device to a wearer;

the optical sensor is a heart-rate sensor;

the first electrode is an electrode of an electrocardiograph sensing system; and

the second physiological parameter is an electrocardiogram.

3. The wearable electronic device of claim **1**, further comprising an input device positioned along a side of the housing and configured to receive at least one of a rotational input or a translational input.

4. The wearable electronic device of claim **1**, wherein the second physiological parameter is a galvanic skin response.

5. The wearable electronic device of claim **1**, further comprising an input device positioned along a side of the housing and configured to receive at least one of a rotational input or a translational input.

6. The wearable electronic device of claim **1**, wherein the optical sensor comprises:

an optical emitter configured to emit an optical signal; and

an optical receiver configured to receive a reflected portion of the optical signal.

7. The wearable electronic device of claim **6**, wherein:

the optical emitter is a first optical emitter configured to emit light having a first wavelength; and

the optical sensor further comprises a second optical emitter configured to emit light having a second wavelength different from the first wavelength.

8. The wearable electronic device of claim **1**, further comprising an input device positioned along a side of the housing and configured to receive a rotational input and a translational input.

9. The wearable electronic device of claim **1**, further comprising a wireless charging system configured to receive power wirelessly, from an external charging dock, through the rear exterior surface of the wearable electronic device.

10. An electronic watch comprising:

a display;

a housing at least partially enclosing the display;

a front cover positioned over the display and defining at least a portion of a front exterior surface of the electronic watch;

a biosensor module defining at least a portion of a rear exterior surface of the electronic watch opposite the front exterior surface, the biosensor module comprising:

a rear cover defining an optically transparent window;

an optical sensor positioned below the optically transparent window;

a first electrode positioned along the rear exterior surface of the electronic watch; and

a second electrode positioned along the rear exterior surface of the electronic watch; and

a third electrode positioned along a side of the electronic watch, wherein:

the electronic watch is configured to measure a first physiological parameter of a wearer using the optical sensor; and

the electronic watch is configured to measure a second physiological parameter using the first electrode, the second electrode, and the third electrode.

11. The electronic watch of claim **10**, wherein the rear cover defines a convex exterior surface.

12. The electronic watch of claim **11**, wherein the optically transparent window is located within a portion of the rear cover that defines the convex exterior surface.

13. The electronic watch of claim **10**, wherein the first electrode, the second electrode, and the third electrode are part of an electrocardiograph sensing system.

14. The electronic watch of claim **10**, wherein the first physiological parameter is a heart rate.

15. The electronic watch of claim **10**, wherein the rear cover comprises sapphire.

16. A wearable electronic device comprising:

a housing;

a band attached to the housing and configured to couple the wearable electronic device to a user;

a touch-sensitive display positioned at least partially within the housing;

a rear cover positioned at least partially within a rear opening defined along a rear portion of the housing, the rear cover defining at least a portion of a rear exterior surface of the wearable electronic device and having an optically transparent portion;

an optical sensor positioned within the housing and configured to emit an optical signal through the optically transparent portion;

a first electrode positioned along the rear exterior surface of the wearable electronic device;

a second electrode positioned along the rear exterior surface of the wearable electronic device; and

a third electrode positioned along a side of the wearable electronic device, wherein:

the wearable electronic device is configured to measure a first physiological parameter using the optical sensor; and

the wearable electronic device is configured to measure a second physiological parameter using the first electrode, the second electrode, and the third electrode.

17. The wearable electronic device of claim **16**, wherein:

the first electrode, the second electrode, and the third electrode are part of an electrocardiograph sensing system; and

the second physiological parameter is an electrocardiogram.

18. The wearable electronic device of claim **16**, further comprising an input device positioned along a side of the housing and configured to receive at least one of a rotational input or a translational input.

19. The wearable electronic device of claim **16**, wherein the rear cover defines a convex exterior surface.

20. The wearable electronic device of claim **16**, wherein the optical sensor comprises:

an optical emitter configured to emit the optical signal through the optically transparent portion; and

an optical receiver configured to receive a reflected portion of the optical signal through the rear cover.

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EXHIBIT G

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EDITED TRANSCRIPT

MASI - Masimo Corp at Deutsche Bank Health Care Conference

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CORPORATE PARTICIPANTS

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CONFERENCE CALL PARTICIPANTS

Kristen Marie Stewart *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

PRESENTATION

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Hi. Thanks for joining us for this session at the Deutsche Bank Healthcare Conference. I'm Kristen Stewart, the medical supplies and device analyst. It's my pleasure to have Masimo here. I have Micah Young and Eli Kammerman with me on the stage. We're going to have a little, short presentation and then we'll do Q&A that follows. Micah?

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Great. Thank you.

All right. Appreciate the opportunity to be here with you this morning and share with you a little bit about the Masimo story.

Before I get started, I'm just going to just touch on forward-looking statements, which involve risks and uncertainties, as well as non-GAAP financial measures. You can find a reference to all those on our website at masimo.com and find more information as well on the GAAP-to-non-GAAP reconciliation.

So just jumping in. A quick overview of Masimo today.

So for 2018, we're guiding to $818 million of product revenue, which is -- represents about 10% constant currency growth over the prior year. We're in over 140 countries worldwide, and we're monitoring over 100 million patients each year with our technology. We're also a leading innovator in noninvasive patient monitoring technologies and a leader in pulse oximetry. In fact, 17 of the top 20 hospitals in the U.S. are fully utilizing our technology.

We're also embarking on a new 7-year plan, and we've talked a lot about our targeted revenue growth of 8% to 10%; long-term operating profit margins, trying to drive to 30% over time. And these targets don't include -- do not include contributions from major products that we talked about in our pipeline or M&A.

So if you look at the technology we build out, and one of the things that we've been out really speaking to investors about this year is just talking more about how broad the portfolio is getting. And we're moving well beyond just measuring oxygen saturation, or SpO2, and we're getting into a lot of different parameters, and we'll talk about more of those here in just a minute with rainbow SET but also expanding out into other monitoring technologies and newer product lines.

If you look at the majority of our revenues today, over 80% are from consumables. So as we put more and more of our devices as well as our OEM devices out in the marketplace and we have a very large installed base, that installed base consumes our single-patient-use sensors as well as reusable sensors.

We have over 70 OEMs that we work with today. They have Masimo labels on their devices that show that they have the most accurate technology out there and in terms of specificity and sensitivity on the marketplace.

If you look at our rainbow -- or our Masimo SET technology, traditional pulse oximetry offers about 2 parameters: SpO2, which is oxygen saturation, as well as pulse rate. With Masimo's SET, you get 5 different measurements. And that include -- it also includes perfusion index, Pleth Variability, PVi, which excludes responsiveness as well as respiratory rate. And then if you look at rainbow, you -- with 1 fingertip sensor, you can measure up to 12 different parameters that include total hemoglobin, Oxygen Reserve Index and those types of parameters. And with 1 acoustic sensor on the neck, you actually get a 13th parameter.

So we get a lot of questions about our revenue per driver, and that continue to expand, and that's what really is helping us to expand as we're getting more and more revenue that we're generating from adding more and more parameters to these devices.

We also have newer product lines such as SedLine, Brain Function Monitoring, O3 organ oximetry and NomoLine Capnography. If you look at the total addressable market for these newer product lines, it's about $700 million to $800 million total addressable market opportunity. And we're just getting started in these product lines, and they're growing at a very fast pace. And we'll talk a little bit more about how they're contributing to that growth rate, but big market opportunity for us in the future.

And then if you look at our products and our technologies, we're really broadening across the continuum of care, from the hospital to the home, also from the critical care unit of a hospital to the general floor.

As you think about our technologies, such as Patient SafetyNet, where you can remotely monitor up to 200 patients across a general floor, it gives you the -- it gives us the opportunity to really expand more and more of our capabilities to get onto the general floor. If you combine that, too, with the capability of Root, where we can connect into third-party devices, such as anesthesia machines, ventilation pumps, all those different third-party monitors, you can also transfer that into Patient SafetyNet where you're remotely monitoring these patients but also feed that in automatically into the electronic medical records of a hospital. Hospitals have made significant investments in EMR, and -- but if they can't fully utilize that capability because it's not well integrated, then they're not getting the full value of that investment.

Then also, during the quarter, we recently received approval -- FDA approval for Rad-97, which is telehealth for home monitoring. And just like Root can connect all these third-party devices and feed that information back into the electronic medical records of a hospital, Rad-97 does the same thing. It has Bluetooth and wireless connectivity options where you can tie into third-party devices, such as weight scales, glucometers, thermometers, and basically feed all that information from the home and all those vital signs of a patient back into Patient SafetyNet, where clinicians can monitor all those different patients remotely as well as feeding that back into the electronic medical records as well. It's like having an EMP beside you in the home. And we'll talk more about that here in a minute.

And then we also announced Replica during the quarter. And Replica is basically an application for smartphones that has 2-way intelligent communication where it can escalate and route alerts to smartphones and tablets for clinicians and they can collaborate amongst themselves. And it tries to find those clinicians who are on duty and escalate those alarms in those occasions so they can respond timely to patients. So this is another great opportunity to really provide that kind of ecosystem within a hospital or a clinical office to where they can monitor patients effectively.

So now turning to our first quarter results.

Revenue -- total revenue, including royalty and other revenue, is $213 million for the quarter. Product revenue increased actually about 12% for the quarter, reaching $204.4 million. And we reported non-GAAP net income of $41.9 million or $0.75 per diluted share, and that was up significantly over the prior year period.

Our financial guidance for the year is -- so our product revenues, we increased those from $810 million and up to $818 million. So a $10 million increase. And that now reflects growth of 10% over the prior year 2017.

Product gross margins, we're increasing 80 basis points versus last year to reach 65.8% for 2018. And then our non-GAAP earnings per share, we've increased that to $2.80 now up to $2.88. And that reflects growth of about 25% over the prior year.

If you look at our guidance, you can see that we've continued to demonstrate strong top line growth of about 10% over the past couple years, and our EPS is growing at about 16% -- a rate of 16% these past couple periods.

Product revenue growth. You'd really break down our growth rates and look at that 8% to 10% growth that we've been reporting out. Of course, our SET technology is an underlying driver for growth. We're growing at multiples of the market. Roughly implied in our guidance, in our long-term growth, is about 6% to 8% growth coming from our core SET technologies and then double-digit growth coming from rainbow and similar newer product lines.

We have a lot of opportunity to continue to expand in the general floor with Patient SafetyNet combined with Root and its capability of hospital automation. And also, with -- our partnership with Philips is a tremendous opportunity ahead to continue to drive more and more growth and share gains within pulse oximetry but also expanding on those additional parameters that come along with rainbow.

And then if you look at the opportunities that we have to expand into new markets in NomoLine Capnography, SedLine Brain Function Monitoring and O3 Regional Oximetry, those are other big markets for us that are growing at a very fast pace. And we're just really getting started in those markets, and it's going to be a significant driver to our growth in the future.

This chart just basically shows the expectations over the next 7 years. We're going from a $3 billion market opportunity to what we believe will be a $6 billion market when you start to bring in SET, rainbow and those newer product lines that connect to Root.

And if you -- just to sum it all up, looking at just reasons why you want to put your money to work with Masimo and invest in Masimo, if you look at our long-term growth rates, we're guiding to 8% to 10% on the top line; long-term gross profit margin of 70% with multiple drivers to help us get to that level; and then operating profit margins growing and improving, expanding all the way to 30%.

And then if you look at our tax structure, we have a lot of opportunity to continue to expand -- or to lower our tax rate over time as we continue to see a higher mix of profits outside the U.S. Today, we have -- our revenues are around 30% outside the U.S. And if you look at a lot of larger players in the health care space, a lot of those companies are around 40% to 50% mix of business outside the U.S. So as we continue to drive more and more growth and have a higher mix of our revenue and profits outside the U.S., it's going to give us the opportunities to also lower the tax rate over time. And that, in turn, will continue to help us drive double-digit long-term EPS growth. And as you saw in the first quarter this year, we generated significant cash flow. We increased our cash position by about $54 million in the quarter up to about $370 million of cash in the balance sheet for the end of the first quarter. So we'll continue to generate strong cash flow and returning great returns to shareholders through growth and profitability. And I just want to give you a little summary there before we go into the fireside chat.

QUESTIONS AND ANSWERS

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Great. Thank you very much. Maybe just to start. For those that aren't familiar with the Philips agreement, can you just talk a little bit about Philips? And when do you expect to see a material impact from that relationship?

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Sorry...

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Oh, sorry. So with Philips...

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

On the Philips relationship?

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Yes. When do you expect to see a material impact from Philips?

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes. So last year -- let me just kind of sum up the history with Philips. So back in 2016, there was an agreement that we settled, which is a long period of litigation between the companies. And basically, when we entered in that agreement, one of the things that we determined together was we both believe that rainbow would become a standard of care. So one of the things with that agreement is over the course of the past year, we've been continuing to integrate our technology, our boards into their devices. And that was why you saw us recognize a lot of nonrecurring engineering revenues last year, is because we completed the integration of rainbow -- our rainbow technology into their devices, their monitors. So that was going well ahead of schedule. We never expected to complete all of that work in the fourth quarter last year. And so that's been a great opportunity for us, and that's where you heard us speak about on the last conference call that we are tracking very well in terms of the rainbow integration. We're putting more and more boards out there. But we -- in terms of the revenue and the contribution from revenue, it's been minimal at this point because it's only been the boards. So we're expecting that it's going to take about 12 to 18 months to really start to see those longer-term sensor contracts come into play from when those get out into the marketplace. So we're -- we could see contribution as early as Q4 this year, but we're expecting more of a contribution in 2019. And then also, we are working on co-marketing with Philips on Rainbow this year but also starting to integrate our technologies for NomoLine Capnography, SedLine Brain Function Monitoring and O3 organ oximetry. So those are the newer product lines that are part of this agreement to start integrating into their technologies as well.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Okay, perfect. And I guess is it part of that relationship with Philips that gives you confidence in your ability to continue to grow at 2x market?

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes, it's several things. So for one, we have a very high renewal rate on our contracts for SET. So we've seen over 98% renewal rate because our technologies are very well differentiated, much more accurate than what's out there in the marketplace today. So high renewal rates. We're also taking new share as contracts continue to come up for renewal from our competitors. We're seeing strong share taking there, just been what we're seeing today. And then you start to bring in the contribution that we could see from Philips in the future we expect to see. That gives us the confidence to basically guide at those growth rates over time. And then you think about the general floor expansion opportunities of continuous monitoring becoming standard of care on the general floor, that can be another leg of growth for us in pulse oximetry.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Maybe you can just talk a little bit more about general ward.

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes. So the general floor -- and I also look at it, too, just more broadly in how we're automating the hospital and then also telehealth for home monitoring. There's a lot of opportunities with general floor expansion where today, our critical care business, which is a majority of our revenue, is -- there's about 150,000 beds in the U.S. that are critical care beds. The general floor is about 3 to 4x opportunity of about 450,000 beds in the

U.S. So if we start to see legislation that comes out that -- or resolutions that come out with different government bodies that promote continuous monitoring as the standard of care on the general floor or even in the home, those are opportunities for us to really -- to accelerate that expansion on to -- into that market opportunity. And we can get into some more of those as well.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Yes. yes. Any questions from the audience? I just want to take a pause. Just wait for the mic. Thank you.

Unidentified Analyst

I'm curious about your approach for direct-to-consumer you mentioned in the home products. And curious also of your perspective about other companies in this space that are emerging like [Alta].

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes. Well, right now -- I'll touch on one. And Eli, if you want to add anything else. Based on what we're seeing and where we're really focused is telehealth for home monitoring. And we just released what's called Rad-97, and that got approved by the FDA for home use, telehealth for home monitoring. What we're starting to see is there's going -- we believe there's opportunity, especially when you think about the opioid crisis that's in the U.S. right now and now we're seeing out there. For example, if you look at what was released, I believe it was yesterday -- sorry, it was released earlier today, about a legislation in Utah where the Senate passed a resolution on deaths related to opioid-induced postoperative respiratory depression. There was a young gentleman aged 21 years old who basically had a tonsillectomy, was given painkillers, went home. And he has only taken half a dose that was required, and about 3 days later, he passed in his sleep, and it was because of respiratory depression. So they call it [Parker's Law] is what basically just came out into Utah. So we're seeing some of those things where they're encouraging the use of home monitoring and basically measuring SpO2 or oxygen saturation levels in the home to make sure that when patients are discharged early from the hospital, that they're being taken care of, that they have devices that are beside them that can interact back with clinicians and give them that safety that they need. So those are some of the things that we believe are opportunities for us to expand not only to the general floor with continuous monitoring but also into the home.

Unidentified Analyst

Just to expand on that a little bit and to be clear, the Rad-97 is a prescribed device. The customers for that product would be hospitals and home health care companies. And they would loan it to the patients on their way out of the hospital through discharge. The patients would use it temporarily at home and then bring it back to the hospital. But regarding our consumer product strategy, we have 2 main products in that segment, and consumer is a very, very tiny portion of Masimo's overall business. We have a device called iSpO2, which is a plug-in for iPhones and Android phones that has an app to go with it and allows people to monitor their blood oxygen and pulse rate in accordance with certain kinds of exercise programs they might be doing. For example, they try to push their intensity and see how low they can drive their oxygen level through anaerobic exercise. There's another device called the MightySat. It's a self-contained what we call fingertip pulse oximeter, which has the display screen built right into the device. That's available through Apple stores and also through Amazon. It costs a few hundred dollars, but, as I said, those products together account for a very, very tiny portion of our overall business. You can see more details about them on MasimoPersonalHealth.com.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Good. Okay, perfect. So we talked a little bit about the general ward and home monitoring. Can you talk a little bit about hospital automation? I think that's your kind of third lever for longer-term growth.

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

That's right, yes. So we've been working with some larger hospital systems as well to -- automating the hospital -- we're not saying automate and replacing the doctors or the clinicians. It's really just trying to automate and improve workflow. So when we talk about that or we talk about our Root device, which is basically, it serves as a hub that connects all these third-party devices that I mentioned before, anesthesia machines, ventilators, monitors, connect them all the way through to where it feeds into our Patient SafetyNet, which allows you to monitor the hospital but then also automate the connection into the electronic medical record. Today, clinicians will go into a room and have to write -- handwrite all the vital signs of a patient, and then that gets input into the electronic medical record at a later time. So this -- we're trying to use our technology and be able to integrate it very well to where it feeds that data in automatically and then there's less room for human error and also saves the clinicians time. So those are some of the things we're working on right now.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Okay. And then in terms of your longer-term forecasts, you've mentioned the 8% to 10% revenue growth, and I think I got you -- I think earlier I heard you say the base runs around 6% to 8%. Is that about right?

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes, that's about right.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

So how do I think about the kind of difference between the 6% to 8% to get to the 8% to 10%? Is it just kind of the 3 new products that you mentioned? What are the market opportunities with that?

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes. So yes, to your point, the base business, which is the -- of course, SET technology, we look at that as being 6% to 8% at a multiple of where the market is growing at. We believe the market's growing somewhere around 3% to 4% overall. And then you start to think about rainbow, which represents roughly 10% of our business, growing at 10% or more, and that contributes about 1 point to our growth rate. And then you add in the newer product lines, Capnography, SedLine Brain Function Monitoring and the O3 organ oximetry, which, I mentioned earlier, was about a $700 million to $800 million total addressable market and it's growing very fast, and we assume about a 20% growth there. And it's still very early stages, but that also contributes 1 point to growth. So you have 6% to 8% on our base business, add 1 point for rainbow and another percentage point for those newer product lines to get to that 8% to 10% range.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Okay. And then just the confidence around being able to get to 70% growth margins, how do you kind of get there from today?

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes, I think we've got a lot of -- still have a lot of runway ahead. We're in the early innings of converting to our RD sensor line from our current -- or from our older sensor line. And that is significantly lower cost than what our existing sensory line is, and it's also a higher quality. So we believe it's going to be well received and adopted. We're seeing that adoption in contracts that we're renewing right now. And again, we're probably in the first inning of that conversion, and that's going to be -- give us a great opportunity to contribute to that 50 basis points of improvement each and every year that we commit to. And then also vertically integrating our manufacturing facility. We see a lot of opportunities to drive more and more economies of scale within our plants and then also to improve our yields on the investment.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Okay. And then the operating margin expansion of getting to 30%, I know some of that's obviously going to be predicated on the gross margin. But is there a leverageable opportunity for P&L?

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes. I think some of the opportunities are our international scale as we continue to grow that segment. It's about 30% of our business. We're seeing that grow anywhere from 13% to 15% range kind of in our long-range growth plan. As we continue to scour our international business, we've made a lot of investments over the past 5 years that are going to -- that we're going to leverage over time and give us the opportunity to really scale that business and drive more profits outside the U.S., which not only does it help improve our overall operating margins but also helps improve our tax rate, because you're getting -- driving more profitability or mix of profits in lower-tax jurisdictions. That's one. And then there's other areas that we're -- we've made investments in the company that -- in terms of facilities and infrastructure that we're going to be able to continue to lever with the growth rates that we're planning.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Okay. And then you kind of touched a little bit on lowering the tax rate. Where are you today? And where do you think you can go over the next (inaudible)?

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes. So we originally guided to 25% coming into the year. Of course, that reflected a change in the new U.S. tax law. We're now guiding to 24%. We'll continue to see a better -- an improved mix of profits outside the U.S. So we brought that down to 24%. We believe that over time, that we can get that down into the low 20s. And we're still working through trying to optimize the structure and determine what that timing would look like, but we're optimistic that we'll continue to be able to get that levered down into the low 20s.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Okay. Are there some questions from the audience? No? Okay, I'll keep going.

You have, I think, a royalty that's going to be rolling off, what kind of gives you, I guess, confidence that it can continue to grow in 2019, I guess, beyond that royalty rate? Is that a major headwind for you? Maybe just comment a little bit about that.

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes, I think yes, our royalty rolls off -- starts to roll off in October this year. We -- we're continuing to get more and more confidence around our ability to grow and grow through that, and we're seeing products like rainbow and some of those newer product lines are really contributing at a faster rate than we expected that we're in our 8% to 10% growth range. So we're seeing very strong contribution from the core business. We believe that we can continue to grow through. And there will be some impact if there's a sizable royalty that does come off, but a lot of that's already been reflected in some of the numbers that are out there. But there's also things that we're looking at in terms of capital allocations decisions where we're going to be opportunistic about opportunities to give back cash to shareholders through share buybacks and those types of things that we're going to evaluate, so.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Yes. Maybe if you could touch a little bit more just about capital allocation and kind of where the capital structure is today and just kind of use of cash.

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

Yes. So first, we've got about $370 million of cash on the balance sheet as we exited the first quarter. There's a lot of opportunity to continue to really reinvest back internally into R&D, and we want to continue to invest, number one, internally to innovate as a company and continue to deliver those innovative technologies into the marketplace. So we will think of -- we think of having R&D as a percentage of revenue somewhere between that 8% to 9%. So that will be number one. And then in terms of other capital allocation, of course, the share repurchase opportunities, we're continuing to evaluate buying back shares. We've -- as you saw last quarter, we bought back some shares, about -- or nearly 200,000 shares in the quarter. And then the third would be just continue to evaluate opportunities. That may be a tuck-in opportunity or a bolt-on type acquisition that brings some synergies to the company. And we're evaluating companies that are in larger markets that are accretive to our top line growth rate of 8% to 10% and opportunities where we feel that it's going to contribute to our profitability and our ability to get to 30% operating margins over time and that are ROIC accretive by 3 to 5 years. So we want to make sure that we're bringing a return that's better than our weighted average cost of capital within the next 3 to 5 years.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Okay. And just in terms of the priority, is it fair to say that priority is share repurchase over M&A at this point or...

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

I think we mentioned on the call -- Joe talked to -- about it a little bit that there's nothing significant or substantial we're looking at right now that's on the horizon that's substantial. So we are definitely considering different allocations of capital. But we're also looking at some of the smaller, tuck-in-type opportunities right now that we're evaluating. But I think it's probably a little different than we were maybe a year ago, where there are some larger things on the horizon.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Yes. What's kind of change your thinking there. As you mentioned, about a year ago, it sounded like you guys were more looking towards M&A. And now it seems like it's more in backseat or kind of -- it's [overall]...

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

I think it's just we're continuing to get more and more confidence in our core business. I mean, the growth rates that we're seeing and the execution on what we're delivering each and every quarter here recently has given us a lot of confidence and that we don't have to rush into anything in terms of something sizable and we'll continue to evaluate. If something comes along and it's strategic and it kind of meets the criteria that we're looking at and trying to vet through financially, I think we'll definitely consider it. But there's no sense of urgency. I think it's -- we're highly confident in the core business and the execution of our leadership team in the company, and I think that's what's giving us the confidence.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Okay. I'm going to try with the audience. Okay.

And with that, I think we'll probably close then and just take some offline.

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

All right, great.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

All right. Thanks again for joining us. I appreciate it.

Micah Young - *Masimo Corporation - Executive VP of Finance & CFO*

All right. Thank you.

Kristen Marie Stewart - *Deutsche Bank AG, Research Division - Director and Senior Company Research Analyst*

Thanks, everybody.
